NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

AN INTRANET FOR THE SYSTEMS MANAGEMENT CURRICULAR OFFICE

by

Reece D. Morgan

September, 1997

Thesis Advisor:	Suresh Sridhar
Second Reader:	George Zolla

Approved for public release; distribution is unlimited.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE September 1997	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE AN INTRANET FOR THE SYSTEMS MANAGEMENT CURRICULAR OFFICE	5. FUNDING NUMBERS
6. AUTHOR(S) Morgan, Reece D.	

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000	8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.	12b. DISTRIBUTION CODE

13. ABSTRACT *(maximum 200 words)*

Intranets are a recent development in information technologies which have provided a wealth of IS utility. "Intranet" refers to the use of World Wide Web technology to manage information within an organization - a self-contained Internet running on a LAN or WAN. Generally, the technologies used include web servers, browsers, hypertext transfer protocol (HTTP), hypertext markup language (HTML) pages, and search engines. Many organizations are now using or building intranets to distribute, collect, and share timely, consistent, and accurate information. The Systems Management (SM) Curricular Office at the Naval Postgraduate School presently relies on an inefficient paper-based system for distributing and collecting information from students. This thesis examines how an intranet can overcome the limitations of the current paper-based system. Rapid Application Development (RAD) methodology is used to conduct an analysis of current data flows and processes, and develop a working prototype of an intranet.

14. SUBJECT TERMS Intranets, Internet Technology, Naval Postgraduate School, Rapid Application Development	15. NUMBER OF PAGES 108
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFI- CATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

AN INTRANET FOR THE SYSTEMS MANAGEMENT CURRICULAR OFFICE
Reece D. Morgan
Lieutenant, United States Navy
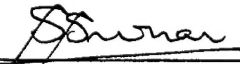B.S., United States Naval Academy, 1989

Submitted in partial fulfillment of the
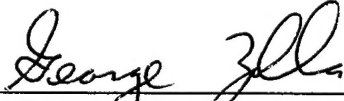requirements for the degree of

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
September 1997

Author: _____
Reece D. Morgan

Approved by: _____
Suresh Sridhar, Thesis Advisor

_____
George Zolla, Associate Advisor

_____
Reuben Harris, Chairman
Systems Management Department

iii

ABSTRACT

Intranets are a recent development in information technologies which have provided a wealth of IS utility. "Intranet" refers to the use of World Wide Web technology to manage information within an organization - a self-contained Internet running on a LAN or WAN. Generally, the technologies used include web servers, browsers, hypertext transfer protocol (HTTP), hypertext markup language (HTML) pages, and search engines. Many organizations are now using or building intranets to distribute, collect, and share timely, consistent, and accurate information. The Systems Management (SM) Curricular Office at the Naval Postgraduate School presently relies on an inefficient paper-based system for distributing and collecting information from students. This thesis examines how an intranet can overcome the limitations of the current paper-based system. Rapid Application Development (RAD) methodology is used to conduct an analysis of current data flows and processes, and develop a working prototype of an intranet.

TABLE OF CONTENTS

viii

x

I. INTRODUCTION

Intranets are a recent development in information technologies which have taken the corporate world by storm. "Intranet" refers to the use of World Wide Web technology to manage information within an organization - a self-contained Internet running on a LAN or WAN. Generally, the technologies used include web servers, browsers, hypertext transfer protocol (HTTP), hypertext markup language (HTML) pages, and search engines. Many organizations are now using or building intranets to distribute, collect, and share timely, consistent, and accurate information.

The Systems Management (SM) Curricular Office at the Naval Postgraduate School presently relies on a paper-based system for distributing and collecting information from students. When students check-in, they fill out many different paper forms; course registration involves pen-and- ink changes to a printout; and add/drop class slips are filled out and processed by hand. Business rules, guidelines, and helpful information is printed in the form of catalogs, instructions, and handbooks. The result of the current paper-based system is redundancy, inefficiency, and built-in obsolescence of printed materials.

A. PURPOSE AND OBJECTIVES

The purpose of this thesis is to examine how an intranet can overcome the limitations of the current paper-based system for collecting and distributing student information in a Curricular Office at the Naval Postgraduate School. The objectives are to analyze the current data flows and processes for exchanging information between the NPS Systems Management Curricular Office and students, determine which processes are best suited for implementation on an intranet, and to develop prototype intranet applications for those processes.

B. STRUCTURE AND APPROACH

This thesis explores both the general concept of intranet technologies and the specific application of those technologies to current processes. A general concept was developed through a (partial) study of the current body of literature - both printed and online - related to intranets. Interviews with key entities in the Systems Management Curricular Office were used to determine the current processes and a structured analysis was applied to those processes to determine which were best for intranet development. A survey of current web development and deployment tools was conducted to select the tools for construction of the prototype.

The thesis is structured in chapters which flow from a broad view of intranets into a more narrow focus of the application of intranets to the Systems Management Department:

- Chapter II: About Intranets - explores the evolutionary and revolutionary technology of intranets and how they are useful.

- Chapter III: Systems Analysis - describes the major SM entities, provides interview highlights, and summarizes the current processes for exchanging information.

- Chapter IV: Process Analysis - describes the structured analysis of each process to determine benefits from an intranet application.

- Chapter V: Prototype - provides screens shots and an explanation of the prototype development, including tool selection.

- Chapter VI: Implementation Issues - explores issues surrounding the deployment of an intranet at the Naval Postgraduate School.

2

- Chapter VII: Conclusion - discusses limitations of the prototype and future enhancements.

II. ABOUT INTRANETS

It's not hard to understand why intranets have become so popular - a study conducted by International Data Corp. revealed that intranets can recover installation costs in six to 12 *weeks* and may generate as much as 1000% return on investment (ROI) [5]. To achieve a better understanding of the intranet concept, the following five sections will examine the technological inheritance of intranets, how they are a unique application of technology in organizations, why intranets are useful, their limitations, and specific applications of intranets.

A. THE EVOLUTION OF INTRANETS

Intranets are the latest development in a continuing trend of creating ever more efficient information systems. The intranet's deepest roots lie in ARPAnet, which was an experimental network of defense research computers created by the United States Government in the late 1960's. ARPAnet (Advanced Research Projects Agency) eventually grew into the Internet. Intranets have inherited their underlying communications protocol, called TCP/IP from the Internet. TCP/IP allows any device to communicate with any other device, regardless of its manufacturer or architecture. [1, 3]

The PC revolution of the late 1980's and early 1990's created a large base of networked Personal Computers (PC) in the American corporate environment. Businesses created Local Area Networks (LANs) and Wide Area Networks (WANs) to connect computers in all parts of the organization. The development of this internal infrastructure was paramount to increasing the information sharing within organizations and these private networks were the first intranets. These networks were initially used for file and printer sharing but a development called client-server computing brought even higher efficiencies to private networks. [1, 6]

The *client-server* model of computing enabled the distribution of applications and data across a network. It is the basis on which many earlier Internet applications, such as email, were implemented and the application of the client-server model to the business world of microcomputer networks created tremendous efficiencies. In a file server

5

environment, a database program could run on a local computer and the data files saved to a remote network drive. But this causes problems, because a powerful computer is needed to run the database locally, and the entire database file must be transported across the network each time that a user needs access. Regularly transporting large files across the network also causes the overall network to run slower. Compared to client-server, the file server concept is very inefficient.

With client-server, instead of running a database locally on each user's machine, the database application and data files are installed on a networked central *server* and authorized users access it remotely over the network using special *client* software designed for this purpose. Instead of transporting the entire database across the network, the server sends only those records that you request and your client software displays them on the screen. An important note about client-server vocabulary: the term client can refer to the software that accesses the server, or the entire combination of local computer, client software, and user. Similarly, the software application installed on the remote computer can be termed the server, as well as the combination of computer, application software, and database. [1,6]
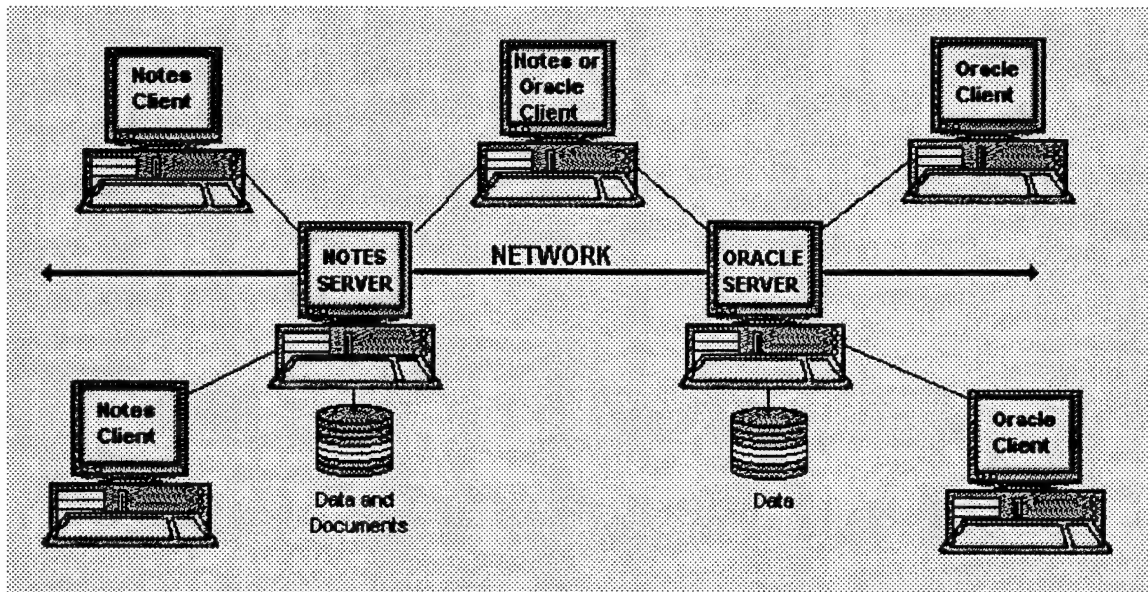
Figure 2.1. Client-Server configuration

6

Figure 2.1 illustrates the client-server architecture; this particular network has an Oracle database server and Lotus Notes office application server which client machines utilize. Notice how one computer can be both a Lotus and an Oracle client.

The introduction of widely used PC networks and information sharing applications in the corporate environment transformed the PC from a computational tool to a communications channel.[9] This transformation of the PC was a vital step in the formulation of intranets, but one more technology was needed: The World Wide Web.

In 1990, researchers at the European Particle Research Center (CERN) developed a new method for transmitting information between computers. The new technology provided a means by which documents could be published, linked, stored, and retrieved much easier than in a traditional network.[1] Tim Berners-Lee, one of the leading figures in the new innovation, envisioned a "web" of interconnected information scattered world-wide across the Internet. Thus, the collection of interconnected documents would later become known as the "World Wide Web". The new method used two complementary technologies:

- <u>Hypertext Markup Language</u> (HTML) - a code used for marking text documents to enable easy online publishing with embedded hyperlinks, font changes, and other features.

- <u>Hypertext Transfer Protocol</u> (HTTP) - a standard communications method that can be used by clients and servers to exchange hypertext (HTML marked) documents over a network. [10]

But the new "web" technology was not immediately successful or widely used. It was not until 1994, when refined versions of a web tool known as a "browser" were introduced, that the World Wide Web began to explode with activity. The new browsers gave the Web a graphical user interface (GUI) which made navigation and retrieval of documents even easier.[1] A browser is a web client which requests HTML coded documents from a HTTP or web server. The HTTP server listens for these browser requests on the network and sends the requested documents to the browser, which

displays the documents to the user. Hence, the World Wide Web is simply a new twist to the old client-server paradigm, where the browser is a client.[19]
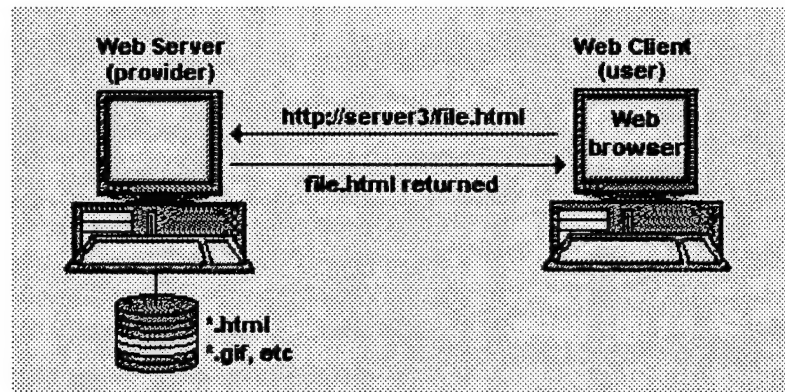
Figure 2.2. HTTP server and client

HTML provides an easy way to use common publishing elements which are known as "tags" to indicate headings, bullet lists, numbered lists, bold/italic font changes, and other document style formats. The author inserts the tags into his document, but they are not visible to the reader. Images and hyperlinks can be added which can call files from the local computer or even remote computers.

HTML is only half of what is needed. Once an HTML document is created, it needs to be transported between clients and servers. HTTP provides for the transport of hypertext files. HTTP uses a standard request format called a Universal Resource Locator (URL). It is very similar to a UNIX or DOS path-name. For example, the URL:

```
http://sam.com/webpages/home.html
```

shows that the HTML document home.html is found on a HTTP server with a domain name of sam.com in a directory named webpages. When sent from a browser to a web server, the URL tells the server where to find a document so that it can be sent back to the browser. A URL can be embedded in a hyperlink so that clicking the hyperlink automatically downloads the requested document.[1]

At the same time that web browsers were becoming popular in 1994, U.S. Government restrictions on using the Internet for commercial purposes were revoked and

8

businesses began searching for ways to exploit the new web medium. The dramatic rise in the popularity of the World Wide Web resulted in a plethora of technologies for developing content, connecting to databases, and managing websites. Due to initial security concerns with the new web medium, businesses were hesitant to buy and sell products via the web. Until the security problems could be resolved, businesses concentrated on using the web to share information such as product descriptions and technical assistance with customers and potential buyers. Browsers, Web servers, and development tools all focused on how to more efficiently share information. [1, 19]

All of the elements were now in place to spawn the intranet concept. A sea of personal computers and networks connected widely dispersed corporate entities. The importance of sharing enterprise information was becoming more important. There was no "first" entity to create an intranet. Technically oriented and user personnel quietly began experimenting with web servers and browsers on their corporate networks, many of which were already utilizing the TCP/IP protocol. When their efforts met with huge successes, the new application of web technology spread very quickly and became known as intranets.

B. THE REVOLUTION OF INTRANETS

1. Grass Roots

While the intranet is an evolution in terms of technology, it is a revolution in terms of how it is applied in a network environment. Intranets are a networking solution which can (and often does) begin at the *grass-roots* level of organizations. Web technology is so inexpensive and easy to implement that it allows lower levels of an organization to implement an intranet before higher management realizes what is happening, especially if lower level users control or have access to useful data. This is especially true for companies that have internal networks which are already using the TCP/IP protocol. Department internal web servers are often installed and managed by self-proclaimed department webmasters. Employee home pages, schedules and events, and organization directories are often the first static HTML pages to be produced.[5, 11, 12]

9

2. Executive Champions

Intranets are now a well-documented and highly successful technology and many recent intranet implementations may not be quite so revolutionary. Corporate executives who have heard about the potential for huge ROI are now pushing intranets in their organization. This kind of high-level, top-down approach to intranets can affect the manner of implementation. A higher level of intranet sponsorship in the initial development of an intranet can significantly impact the goals and what the implementers consider critical elements for success. People at lower levels in an organization use intranets to achieve cost savings and easier information access. The executive levels expect an intranet to create a fundamental change in the way that they do business through increases in organizational and individual productivity. Improved decision-making, higher quality information, and better information visibility are the results that executives expect the intranet will provide to support these productivity advances. Easier information access and cost savings can be provided by intranet technology alone, but improvements in information quality, decision-making, and productivity require development of the organizational and management infrastructure. [4]

C. BENEFITS OF INTRANETS

In creating intranets, there are several main reasons why web technologies have such a high impact when applied to business networking applications. These reasons are discussed below; some in the context of improvements over the traditional business client-server paradigm while others are attributed to the application of the web browser as a universal client.

1. Improvements Over Client-Server

While client-server optimized both the network and the attached computers, it added a tremendous amount of complexity to the corporate IS environment, in terms of managing users and client software. All of the client-server solutions are proprietary, very

expensive, and interoperability of different systems is close to impossible. Web technologies provide the following improvements to client-server:

a. Interface: Web technology has vastly simplified the retrieval of information. With client-sever/file server, the following steps were required to retrieve a document from a server:

- determine file location and format
- log in to computer where file is stored
- open an application which can display the particular type of format (MS Word
   for .doc files
- find the file directory
- open the file
- print or download file
- close file
- log off of server

Web technology has reduced these steps into just one click of a mouse. [1] This is an amazing transformation, and using web technology on an intranet may dramatically change the way that we interface with complete systems. The GUI has been defined by Microsoft as an iconic desktop. But, although this might be what technicians like - and often believe it's what users like - it may not be the interface with which most business people are comfortable. With HTML you can build an 'End User Comfortable Interface' which can be tailored to fit exactly what users need. The beauty about using Intranet technologies for this is that it is so simple. An HTML hyperlink does not necessarily take you to another page - it could ring an alarm, run a year end procedure or perform any other computer action. Microsoft's Windows operating systems are loaded with functionality, but individuals probably only need 5% of the total functionality. The other 95% can cause support problems and disruption. Now, with the Intranet tools, you can paint reality in HTML and make an in-context and uniform front-end to all computer-based resources. In doing so, not only can you create interfaces that users can use and

11

appreciate, you can also remove the 95% functionality and access to elements that specific users don't need. [2]

Additionally, client server application interfaces are difficult to change, because of the major task of updating the many hundreds or thousands of copies of the client applications which may be spread throughout an organization. With a web system, the interface resides in only one place-the server. It can easily be tweaked and adjusted until it meets the user's exact needs. [1]

b. Network efficiency: In the traditional client-server model, a live connection is made between the client and the server. A user logs on to the server and the connection between the client and server remains open until the user logs off. On an intranet, there is no extended connection between client and server. The client browser fires a URL request across the network to a server, which fires the requested information right back to the browser. The server is occupied only as it long as it takes to fulfill the client request.

It is important to note, however, that this efficiency is only an advantage with transaction processing. Transporting large amounts of data in batches, known as batch processing, is more efficient with the extended connection of the traditional client-server architecture.
[1, 22, 24]

c. Web systems are open: a web server by default allows access to anyone with a web browser, regardless of whether they are authorized to log into the computer that runs the web server. A web server can be protected from unauthorized users, but unless specifically protected, it is open to all users by default. In a traditional client-server system, users cannot access the server unless they are specifically permitted. A user must have an account established on the server or it must be installed so that it is shown on each user's computer as an accessible application or drive. A web server can be seen by anyone on the network with a web browser.

The application of such an open system changes the way that networks are used and administered. In a traditional client-server environment, more users for a networked application translates to a greater administrative burden. An account must be created for each user and the user's computer must be configured to access one or more servers. In a

12

corporate environment, administrative support for thousands of users is a huge task. In a web system, network access administration disappears or is substantially minimized. In this manner, web technology is <u>more scaleable</u> than client-server. A single web server can be used to administer a small department or an entire enterprise. [1, 22, 23, 24]

d. <u>Non-proprietary</u>: Because intranets use the non-proprietary standards of the World Wide Web such as TCP/IP, HTML, and HTTP, the same client and server can support a large number of applications. In the traditional client-server environment, separate client and server software must be purchased for each individual network application. Thus a web system is less expensive to implement. The non-propriety nature of web technology also allows platform independence. Traditional client-server applications are developed to operate on a single platform, such as an Intel-based PC with a Windows 95 operating system. Thus, an application which is designed for Windows is not inter-operable with the same application designed for UNIX. Web based applications, on the other hand, will work on any kind of machine with a browser. [2, 22]

2. A Universal Client

Due to the inter-operability mentioned in the previous section, any individual and/or department on the Intranet can interact with any other individual/department and beyond to partners and markets. Thus, the web browser is a type of 'universal client' which facilitates interaction.[25, 26] This interaction is usually in the form of:

a. <u>Publishing</u>: Documents which can include human resource guides, newsletters, reports, maps, company facilities, price lists, product information literature, and any other document which is of value within the corporate entity. The ability of the entire corporate entity to easily view documents is where intranets can achieve significant cost reduction as well as much more efficient, timely and accurate communication across the entire corporate organization. [23]

To illustrate the cost savings that web-based publishing can bring, imagine a company policy manual for a large organization. Once the document is complete, it is printed and many copies are reproduced and bound. Mailing labels must attached to some of them for shipping and they are transported to various locations. They must be

distributed by hand to the place where it will be placed upon a shelf and maybe never used. But organizations are always changing, and it won't be very long until a new version is needed. By publishing documents on the web, all of the printing and shipping costs are saved. The document is easily updated, and users will always see the most recent edition.[1, 23]

b. <u>Retrieving information</u>: URLs can retrieve HTML files stored in a remote computer, but a URL can actually carry almost any kind of information between a client and a server. [19] A client can even send a URL which will run scripts on the server side. This is possible due to an extension of the Hyper-Text Transfer Protocol (HTTP) called Common Gateway Interface (CGI). CGI allows data to pass in both directions between client and server, which makes it possible for someone using a client workstation to control applications which reside on the server. This feature is what allows online content searches and interactive database queries.[16] Users can enter search criteria for a document search to find all references to "Microsoft", for example, in a huge collection of documents. [1] Databases can be connected to web pages that allow users to recall job order 4321 and related information. These pages are interactive, online *forms* which use special HTML tags to specify drop-down lists, checkboxes, and text boxes. Information which is typed into the form on the client machine is sent to the server as part of a URL or a variable. The server hands the data to the CGI, which then passes it to another application which resides on the server, such as a database. If a response is needed, the CGI will pass it from the application to the server, which will send it to the client.[1, 16]
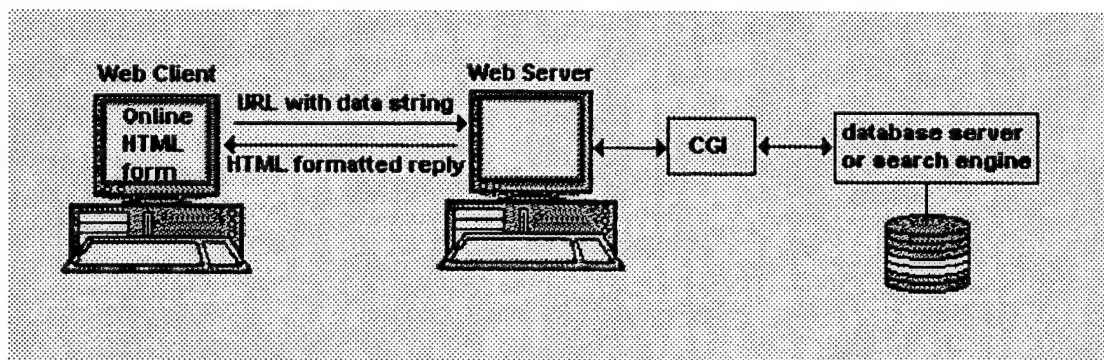

Figure 2.3. CGI configuration

14

Connecting web pages to back-end applications such as databases or document collections provides access to an enormous wealth of information. Additionally, it allows for the *collection of information* from users. [23]

c. A playback device: An intranet will reside on inherently a high-bandwidth corporate network, so it does not suffer from the slow data rates that afflict most Internet users who dial-in via modems. This large bandwidth gives the intranet the ability to easily handle multimedia such as audio, images, and video, which increases the level and effectiveness of communication. [19] Browsers can be equipped with add-on software called *plug-ins* which enable viewing multimedia. Intranets are already beginning to be used for video-teleconferencing (VTC) between dispersed corporate groups. [20, 23]

d. Software distribution: Internal Administrators can use the Intranet to deliver software and up-dates 'on-demand' to users across the corporate network. [1]

e. Mail: Mail is essential for individual to individual, or individual to small group, communication. [2] The incorporation of the mail utility into the browser and simple methods for attachment of documents, sound, vision and other multimedia between individuals are making internal communications much more effective.[22]

D. LIMITATIONS OF INTRANETS

1. Security

Because the intranet is implemented on a private network, such as a corporate LAN (Local Area Network) or WAN (Wide Area Network), it is assumed to be more secure because access to the network is restricted. Users must usually log in to gain network access and a firewall or router can prevent unwanted visitors from other networks (i.e. the Internet). But intranets give users unprecedented access to their organization's data and some experts estimate that as much as 80% of all security losses are committed by company insiders.[13] Intranet security can be accomplished through the use of IP restrictions, passwords, encryption, and firewalls.

a. IP based access control

With IP based access control, the Web Server is configured with a list of 'allowable' Internet addresses. Users running browsers from these address are allowed access to the Web Server system. If a user runs a browser from an address that is not on the list, the user will be returned an error message generated by the Web Server, and be denied any pages or Web based application supported by the Web server.

IP based restrictions do not provide a complete security approach. IP addresses as well as domain names can be spoofed. This results in the Web Server assuming that the connection is from an authorized host, when in fact the user is merely mimicking an allowable address. Some servers can be set up to perform extra DNS checking - converting both the incoming IP address to a host name, and then converting the host name back to an IP address. The two addresses must match before access is granted. Although this does add an additional level of security, the extra DNS lookup results in some performance degradation.[27]

b. Username and Password

The User Name/Password restriction approach requires that the user enter a name and password via CGI scripts when first contacting the Web server. The Web Server compares this name and password against allowable names and passwords, and access is only granted if there is a match against the list of accounts the Server has been configured to accept. Password protection provides a significant level of security, but only if passwords are well-chosen and periodically changed. Poorly chosen passwords are easily guessed. There are many password guessing programs available, and many Web Servers cannot be configured to deny access after repeated attempts. In addition to web servers, access to the local network itself is often password protected, and data-base management systems with CGI driven web interfaces are password protected.[27, 29]

c. Encryption

Since all HTTP transferred data passes through numerous unsecured nodes on its route between HTML browsers and HTTPD servers, it can be intercepted and

16

analyzed during transit. User names and passwords, credit cards, or any other sensitive data can be exposed. Encrypted data can also be intercepted. This data, however, is of little use to the 'eavesdropper' if it is sufficiently encrypted. Encryption standards such as Secure Sockets Layer (SSL), Secure HTTP (S-HTTP), and Kerberos provide a means of protecting information from unauthorized viewing.[27] Other forms of encryption such as digital signatures and certificates allow for authentication of information sources. A digital signature provides a means to confirm that an electronic document came from a specific person. A digital certificate is similar to an employee security badge. It can be used to validate the identity of a client or a server. [30]

d. Firewalls

A firewall is a security mechanism for controlling access between a private, trusted network and an untrusted outside network. Firewalls provide a means of enforcing security policies that define acceptable uses of applications and acceptable access to information - for entities inside and outside of the network. Since all network communications between a trusted network and all other types of network must pass through the firewall in a well-designed network, the firewall plays the role of network "traffic cop".

Access rules on the inbound side might define acceptable access to specific servers or other host by time of day, by type of application, and/or by type of file. On the outbound side, policy might prevent users from accessing specific Web sites or even specific pages within a Web site. A communication source, destination, and application might all be included in a security policy. Inbound or outbound communications that fall outside of the parameters of the policy are considered security violations, and the firewall should be configured to detect and prevent them.[28]

e. Other security problems

Malicious attacks against networks are more difficult to confront. Automatic email generators can clog a network with a continuous spray of mail. Viruses can be attached to email in the form of an executable program or an infected file and

17

distributed throughout an organization very rapidly. The best protection against viruses is to aggressively push anti-virus software to all users. Stamping out all viruses can be a daunting task because of the large volume of documents which must be scanned.[4, 13]

Increased security comes with a price. More stringent security measures cost money and time to procure and operate. Increased access control mechanisms increase the complexity of the network and applications for users. If there are too many passwords to remember, users will simplify their lives by using one or a few easy to remember (and easy to guess or break) passwords for accessing all systems. One solution for this problem is using security servers which map all access permissions to a single encrypted username and password authentication system for the entire network. [4, 12]

2. Content Management and Maintenance

A grass roots intranet development, described early in this chapter, can lead to web chaos. Without enterprise standards and procedures management, entities can quickly produce a morass of static web pages which are difficult to navigate. At some point, a higher level of management must identify and enforce a hierarchy and an interface which allows easy location of intranet resources and standards for controlling download times and information updates. [14]

The problem of content management and maintenance can be demonstrated by an Internet key word search on the word "Pentium". The search results provide thousands of HTML documents which are a conundrum of personal opinions, technical reports, media articles, etc. Some documents, provided by amateur technophiles, will be inaccurate.[15] Thus, one advantage of using Web technologies - ease of publishing - can actually be a problem in an intranet. The entity which is responsible for providing written information should also be responsible for maintaining the content of their web documents. By incorporating the document maintenance process which is already in place into the maintenance of web documents, content can be somewhat controlled.

3. Limitations of Current Technology

a. Stateless Protocol

The Hyper-Text Transfer Protocol (HTTP) is a stateless protocol. Each transaction is treated independently from any other. Every time that a browser sends a request to a server, the server opens a new connection, sends the requested document, and closes the connection. While this characteristic preserves network bandwidth, it has one major implication for the development of interactive Web services: the problem of maintaining context. In order to achieve some degree of continuity from one Web page to the next within an interactive Web application, some method of storing the user's state is required. [16, 17, 18]

Fortunately, the Common Gateway Interface (CGI) described earlier in this chapter (and the other comparable proprietary APIs) and the use of HTML "cookies" have overcome this limitation. A CGI program can store the state of each user in a file located on the server. Asking the user for some form of identification, such as an email address, a name and password, or some combination of these enables the server to distinguish and track users. Hidden variables, which the user cannot directly modify, can also be passed to the CGI program just like any other form input variable. A combination of hidden variables can be used to define the current state of the user.[16] A HTML cookie is a mechanism by which server-side processes can store and retrieve information on the client side of the connection. The cookies are pieces of information about a user, usually entered by the user himself in an interactive web page. The cookies are set in the header of a returned document and included in that header is a range of URL's that the cookie is to be returned for. The client will store the cookie and when it requests a URL that matches the specified range for that cookie, it sends it along with the request. Thus, a web page can "remember" (i.e. save state) a user's name, email address, etc.[17, 18]

b. Display

A Web browser, not a server, controls how an HTML document is displayed. The user can determine what size, type, and color fonts are used to display text and any formatting, style, and graphic design provided by the author will be lost. This is a

19

serious problem for authors who wish to be identified by their individual talent in style and design, or for corporate entities who desire to be associated with a singular corporate image. This problem can be alleviated, to some extent, by using HTML tables for the layout of HTML pages. This maintains the layout of a page, but to preserve the appearance of text, authors must shun HTML in favor of other web-based publishing alternatives. A file can be referenced directly in a URL, which allows the file to be stored on the server in it's native format (such as MS Word). The user downloads the file and views it using the appropriate software which resides on the client. The document will be available on the intranet, and the format will be maintained. Transferring files on the network, however, uses more bandwidth. Proprietary document viewing software (such as MS Word) must also be available for on all client machines, which can be expensive. Another alternative is to use an intermediate application such as Adobe Acrobat™. Files can be created in any word processing format and converted to a proprietary file format called .pdf (portable document file), which compresses the document and preserves the formatting. Adobe provides a plug-in viewer for browsers which allows the browser to automatically download and view .pdf documents. The problems of transporting files across the network and needing special viewers exists for this alternative as well, although Adobe has recently introduced server-side software which provides for byte-streaming of .pdf documents to regain network efficiencies. [1, 19]

E. APPLICATIONS OF INTRANETS

Although intranets can be applied to industry-specific or general needs in limitless ways, intranet applications generally fit into one of three categories: communications, applications, or collaboration. The following sections describe each category and provide some specific examples from industry.

1. Communication

Communication occurs on a one-to-many basis between teams, departments, or entire corporations by posting of information on web pages, reducing bulky, easily outdated paper-based documents. This use of an intranet brings an immediate pay-back to

organizations, eliminating the costs of producing, printing, and shipping corporate information.[23] Sun Microsystems uses an intranet to provide access to human resources data, sales information, and technical data. A weekly 2-3 minute audio clip from the CEO provides employees with insight into corporate goals and strategy. [20]

2. Applications

Applications enable two-way interactions, such as logging help desk requests or enrolling for benefits. Whether an employee needs to develop a report, analyze data, or learn about the company's customers or policies, using web technology linked to legacy data can be an intuitive and efficient alternative to the frustrations of "telephone tag" or paper pushing.[23] Sandia National Laboratory, a U.S. Dept. of Energy Nuclear Research Facility, uses an intranet to allow personnel to fill out weekly time cards and view human resources data such as vacation time. Most employee manuals and regulations are can be viewed, conference rooms can be scheduled, and general announcements can be posted, all through interactive intranet forms. A substantial amount of Sandia's engineering knowledge base also exists on-line. One example is a utility which matches materials to be welded with the proper welding type, tool, and tool settings to achieve various degrees of weld quality.[12]

3. Collaboration

Collaboration represents many-to-many interactions. This category includes news groups that facilitate direct exchanges of information between members, with posted information available to others, resulting in a corporate "knowledge base." People subscribe and can view a screen with subject lines, authors, and news article numbers. Each of these items is the beginning of a "thread" that starts when someone sends out an article or email; then readers can trace these threads deeper as they wish.[23] At Johnson Controls, a $9 billion parts mfg., an intranet was initiated and deployed by their engineering services group to provide easier access to technical information and training documents for over 5000 personnel. Individual web pages enable employees to search for other employees who have special skills or experience that can help with projects. The

resulting collaboration at lower levels between employees of different departments has created many new ideas. [5]

III. SYSTEMS ANALYSIS

The earlier chapter focused on the intranet concept and associated technologies. The remaining chapters of this thesis will examine the specific application of an intranet to an organization, the Systems Management Curricular Office at the Naval Postgraduate School (NPS) in Monterey, California.

A. BACKGROUND

The Naval Postgraduate School is an academic institution which emphasizes study and research relevant to the interests of the Navy and the Department of Defense (DoD). Each armed service identifies military billets that require specific graduate level education for successful performance. These billets are known as subspecialty coded billets. Sponsor commands such as the Naval Sea Systems Command and Naval Air Systems Command identify the skill requirements for subspecialty coded billets and the Naval Postgraduate School administers curricular programs to meet their promulgated skill requirements. The sponsor commands are also known as *curricular sponsors*.

The NPS student body is nearly 1,500 officers from the five U.S. uniformed services, approximately 25 allied countries, and a small number of civilian DoD employees.

Members of the faculty are organized into eleven academic departments and four interdisciplinary academic groups. Each is supervised by a chairman who reports to their respective Division Dean (See appendix C, NPS org. chart). Over 80% of the teaching staff are civilians of varying professional rank and the remainder are military officers.

Separate from the academic departments/groups are the curricular offices. These offices are staffed by naval officers and civilian faculty/staff members whose primary functions are: (1) academic counseling and supervision of students, (2) curriculum development and management to ensure attainment of professional and academic objectives, and (3) liaison with curricular sponsor representatives. In performing these duties, the curricular offices routinely interact with the academic departments. Each office is managed by a naval officer who is known as a *Curricular Officer*, and in academic

functions he is assisted by civilian faculty who serve as *Academic Associates*. Other civilian and military staff assist in administrative functions.

Students are grouped in accordance with their curricular programs and are assigned to one of ten curricular offices for program supervision and academic and professional counseling. Students assigned to a curricular office pursue similar curricula. Students are moved through each curriculum in batches. Students who begin the same curriculum at the same time are designated as a *section* and given a unique identifying code, such as PM61. The senior student in each section is designated as the *section leader*.[31]

B. RESEARCH SCOPE AND METHOD

Conducting an analysis of each academic department, group, and curricular office of the Naval Postgraduate School was impossible due to time and resource constraints. Limiting the scope of research to one aspect of the school, student administration, enabled a detailed analysis of the processes involved. The Systems Management Curricular Office was selected as a model to analyze. The entities, processes, and information flows which affect students assigned to the Systems Management Curricular Office were documented to evaluate their potential for application to an intranet. The primary method for collecting information was interviews with some of the major entities (in the curricular office) who are concerned with student administration. From these interviews, a clear view emerged of Curricular Office processes and the entities which affect them.

C. SYSTEMS MANAGEMENT CURRICULAR OFFICE

1. Major entities

The main entities involved in Systems Management (SM) student administration are:

a. Curricular Officer: Ensures that their curricula meet Navy needs and the proper administrative operation of the respective offices.

24

b. <u>Curricular Officer Education Technician</u>: Ensures that curricular office student records are accurate and updated in a timely manner for download to the master database

c. <u>Academic Department Education Technician</u>: Tracks educational issues for a department such as student course validations, which instructors teach which courses, and ordering textbooks.

d. <u>Academic Associate</u>: Part of the curricular office staff, they are faculty members selected for this part-time assignment. They are responsible to the Deans for the integrity and academic soundness of one or more curricula for which a curricular office is responsible. There is usually one Academic Associate for each curriculum attached to a curricular office.

e. <u>Admissions Office</u>: Tracks future students.

f. <u>Scheduler Office</u>: Assigns courses to classrooms and students to courses.

g. <u>Registrar Office</u>: Ensures that student academic records are accurately maintained in the master student database and maintains archives of past student records.

h. <u>Faculty</u>: Teach and advise students, conduct research, and play a role in school-wide policy determination and planning through various Councils.

i. <u>Students</u>: Take courses and conduct research culminating in a master's degree and subspecialty code.

j. <u>Curricular Sponsors</u>: DoD entities which sponsor the various curricula at the school and provide education requirements.

k. <u>Section</u>: Students who enroll in the same curriculum at the same time are a section.

l. <u>Section Leader</u>: The senior student in a section, this person is responsible for administrative matters regarding the section.

m. <u>Curricular Office Focus Database</u>: There is only one Focus database at NPS. Each curricular office, and other entities are given space in that database to manage their own information. That space is considered to belong to the Curricular Office, even though it is part of a larger database.
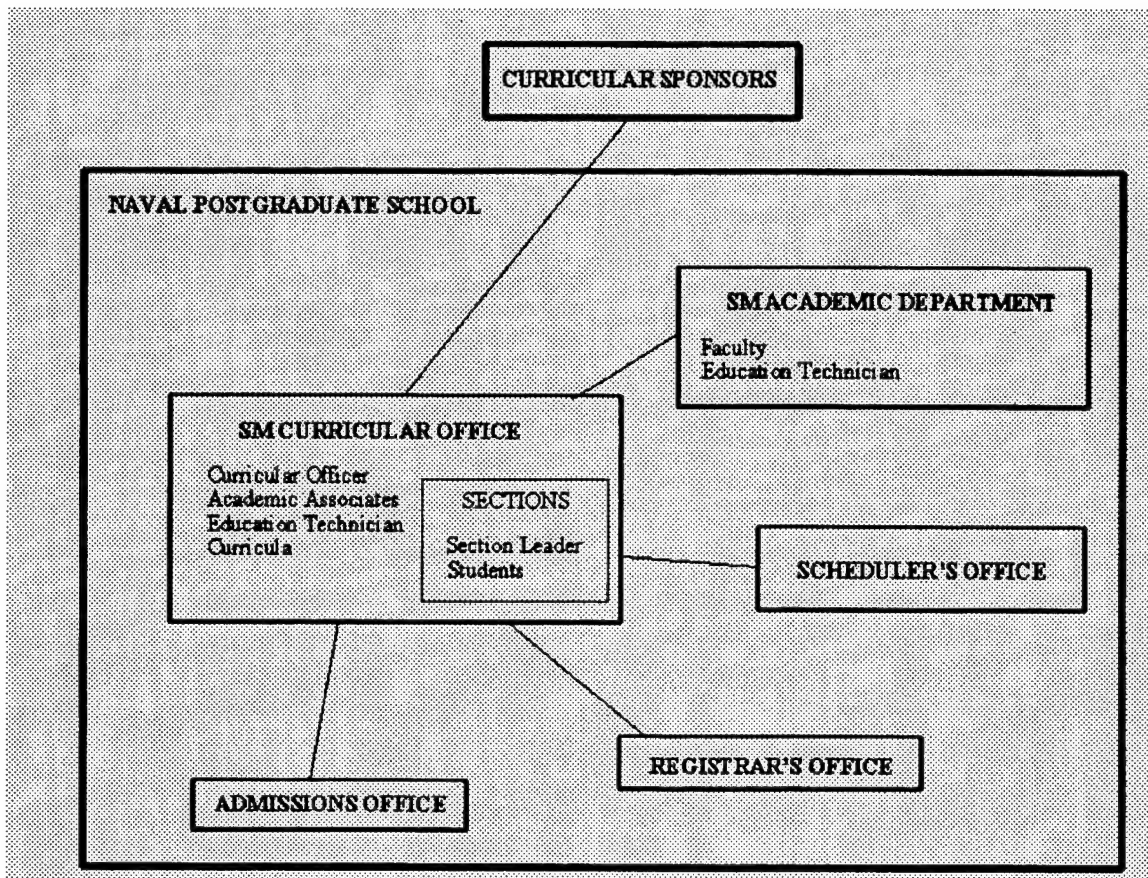
Figure 3.1. NPS Entities Block Diagram

2. Process Descriptions

Figure 3.2 is the zero level logical data flow diagram of the processes in the SM Curricular Office. This section provides detailed descriptions of these processes and appendix B contains more detailed data flow diagrams.

a. Add-Drop Courses

Students can add a course in the first two weeks of a new quarter and can drop a course up to six weeks after the start of a new quarter. When a student desires to drop or add a course, they fill out a three-part form(see Appendix A), have it approved by the course instructor, the academic associate, and the curricular officer. Once the change form is approved, students route it to the Curricular Office Education Technician (ET).

The ET uses approved add/drop slips to update student records in the Systems Management Focus database. The white copy of the form is sent to the registrar for filing. The yellow copy is placed in the student's file which is maintained in the curricular office and the green copy is routed to the student. The Registrar's Office Focus database is updated once per quarter by downloading the changes from the curricular office database. In the second quarter of 1997, the SM ET processed more than 215 add/drops per quarter.
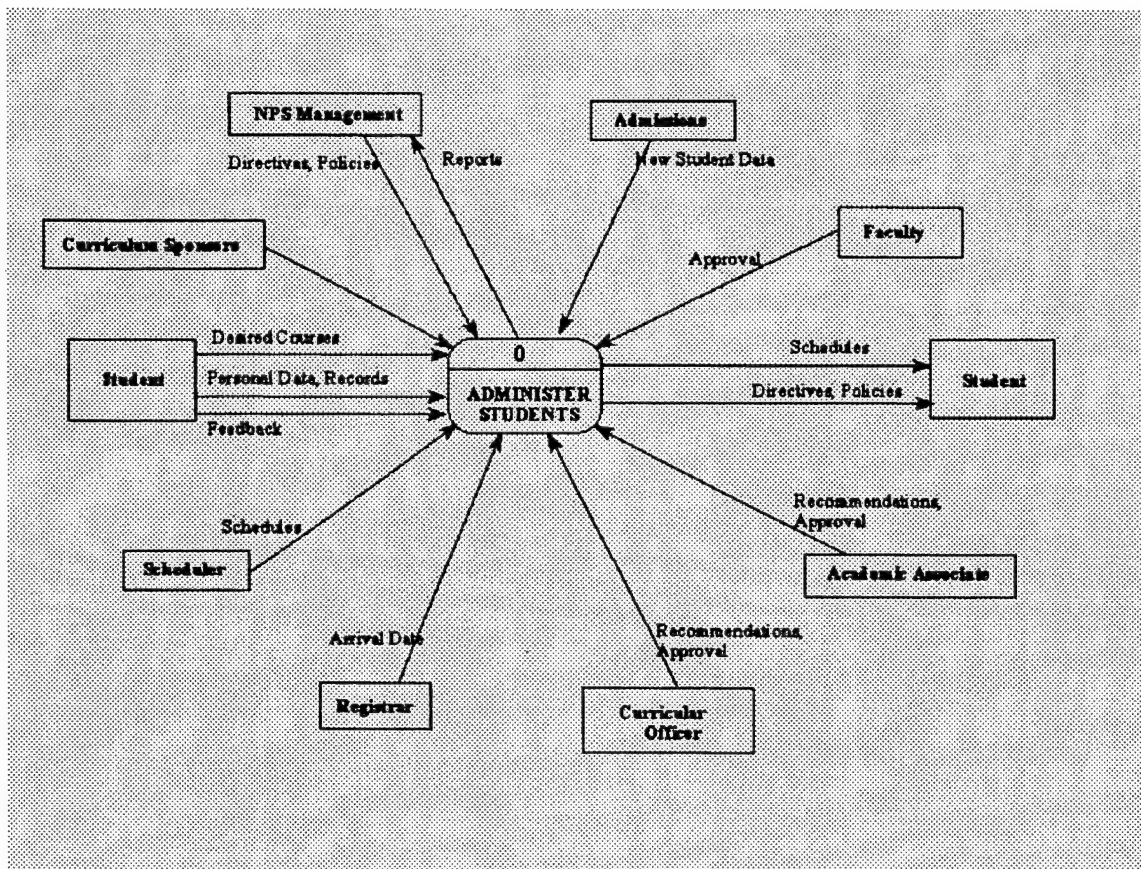
Figure 3.2. Level Zero Process Chart

b. Pre-registration

At the beginning of each quarter, the Scheduler Office prints a listing of students by section for each curricular office which shows what courses students have requested for the next quarter. If changes are required, students hand-write them on the printout. The Ed. Tech. then enters all of the changes made to the printout into the curricular office database. The Registrar's Office downloads the changes to the student

27

schedules from the curricular Office database. Class schedules are determined and then printed by the scheduler. Each curricular office receives two copies of the schedule printouts: one is provided to students and one is maintained in the office.

After students pre-register, the ET must identify any students who have signed up for courses which are not being offered that quarter. The curricular office Focus database cannot execute a query for that information, so the query is run on the Registrar's central database and printed. The printout identifies students signed up for courses not offered with a question mark. The ET manually inspects the printout for question marks and also for students who have not registered for at least four courses, which is a school requirement. Determining students not signed up for four courses is a manual process because the curricular office Focus database does not recognize thesis time slots as a valid student activity, making it impossible to get accurate information by running a database query.

c. Students take Courses

Students receive their class schedules for the next quarter near the end of the present quarter. Appendix A contains a sample student schedule. To determine which textbooks are required for a course, students must reference their schedules against a master document located in the student lounge to determine their professor's name (it is coded on the student schedule) and then refer to the textbook listing to determine which textbooks to purchase for the quarter. Not all students do this. Some do it early so that they can purchase textbooks before the supply is depleted, while others would rather wait until class begins to find out what they need.

Students then participate in the class, in which the professor provides information about the course, such as course requirements and goals, reading syllabus, assignments, course notes, etc. At various intervals students also are given tests and quizzes. Students provide to the professor the required assignments such as homework and projects. Students receive grades from the professor. Throughout the process students receive grades.

Halfway through a quarter, the Registrar Office prints a single page summary of student data for each student, including the courses in which their records show a student is enrolled. This report is distributed via student mailboxes. The student verifies the accuracy of the report. If changes need to be made, the student indicates the changes and returns the sheet to the Registrar Office. If no changes need to be made, the student keeps the sheet.

Similar to the student report described above, midway through a quarter the Registrar prints a report of students enrolled in each class and routes it to the appropriate faculty. The instructor verifies the list, makes necessary changes, and returns it to the Registrar.

At the end of the quarter, instructors receive another list of students from the Registrar upon which student final grades are handwritten. The list is returned to the Registrar Office and student grades are entered into the Focus database. Two copies of a quarterly grade summary report are then printed for each student. One copy is routed to the student's mailbox and the other is routed to the curricular office. The curricular office copies are forwarded to the appropriate academic associate, who screens the reports for potential academic probation cases. The sheets are then returned to the curricular office for filing in the student's folder.

d. Matrix Management

When a section reaches the midpoint of their course matrix, the Registrar Office prints a list (by student section) of which courses a student will attend in the remaining quarters, based on their matrix. There are blanks in this schedule for several elective classes, known as focus areas, which students select based on interests. Students write their preferred electives on the printout and the data is entered into the Curricular Office database. The Registrar downloads the updated student matrices and uses this data to forecast which courses will be taught and which dropped.

Also, students who validate courses can alter their individual matrix so that they can take additional electives or even complete their education early. The Academic Associate for a curriculum provides advice to students concerning matrix changes.

During the interview, the current ET noted that students hesitate to choose their electives so far in advance. Many are unsure which electives interest them and will not write down any choices at all. This can be a problem if the scheduler is using the data to forecast courses needed. The ET suggests that students enter several choices; a total of six courses can be entered into the database for each student per quarter. If a student is taking four courses and one is an elective, then there are a total of three slots open for students to enter possible electives. During the pre-registration process for that quarter, the student can choose one of the three elective choices and drop the others.

e. Base-Matrix Management

This process belongs to the curricular officer and academic associate. They receive inputs from:

- students providing feedback about course content or the structure of a curriculum matrix
- curricular sponsors concerning skills necessary for performance in subspecialty coded billets
- faculty who teach the courses

Based on these inputs, the curricular officer and academic associate together determine the structure of the base matrix - the sequence of courses - for a curriculum. If changes are made to a curriculum matrix, they are referred to curricular office education technician, who maintains the basic matrix for all curriculums in SM. When a change is made to a matrix, the ET must update it in the following locations:

WordPerfect file
Student Lounge Kiosk file
Curricular Office Focus database
SM Web page
Registrar central Focus database

When a change is made in scheduling that will affect an entire section, Focus can delete a class for a section, but cannot add. Each student record must be updated individually. The Ed tech needs this functionality for efficiency.

f. Reports:

The SM ET also prepares, validates, or submits data for the following reports:

Graduates/degrees/phonetic spelling	Quarterly
Nominations for Degrees and "with distinction"	Quarterly
Requests for Thesis extensions	Yearly
Nominations for Subspecialty codes	Quarterly
Academic probation report	Quarterly
Student scheduling	Quarterly
Enrollment summary	Quarterly

The enrollment summary is prepared by hand. The education technician queries the curricular office Focus database and tallies results by hand for systems management and then for each curriculum - they must balance. This report requires two to three days to finish. Inter-curricular transfers affect the numbers, so the ET must always do some adjustments by hand, regardless of the degree of automation.

The graduation report determines which students are qualified for graduation, and the ET must compare individual student matrices against their basic curriculum matrix to ensure that the student has fulfilled the requirements. This is accomplished via visual comparison of each student record against their respective curriculum base matrix. This report consumes an enormous amount of time (up to three days). The graduation report is always prepared before the last quarter, so that students who missed a core course can make it up in the last quarter. The graduation report query for total numbers is run on the Focus database, then data is retyped using a word processor to create the report.

31

g. New Student Preprocessing

The Admissions Office maintains a special Focus database file for each curricular office in which they place the name, social security number (SSN), and arrival date of incoming students. The SM Education Technician checks the "new admissions" file every day. Incoming student files are downloaded and assigned to a section. The section is based on the arrival quarter, i.e.: PM 61 arrived in 1996, first academic quarter.

The SM ET must validate all data downloaded from the Admissions Office, but especially the arrival date. The arrival date is of utmost importance because once a matrix is assigned to a student focus file, it cannot be deleted, only changed. If the arrival date is wrong and the ET doesn't catch it, the ET must retype the entire student matrix. Matrices are assigned based on arrival date. There are six different types of matrices which can be assigned to an ITM student based on whether the student will take a full quarter refresher, half-quarter refresher or no refresher. The same options exist for international students. As a result, the ET spends a lot of time verifying student arrival dates. During an interview, the present ET could not quantify how much time ... "it is a continuous process... I never stop doing this."

To validate the data, the ET first looks for odd arrival dates, such as the middle of March. When an odd date is found, the ET calls the registrar's office (not the admissions office) to compare their arrival dates against the ones in the SM database. But new student downloads can have non-suspicious dates and also be wrong. One case that she showed me was a student listed to arrive in January 1997 was later found to be arriving in January 1998.

One month prior to the start of a new quarter, a confirmed list of new students and their SSNs is sent to the Education Technician for the SM academic department, who pulls their undergraduate education transcripts from the registrar's office for course validation screening. After validation screening, the transcripts are sent to the SM Curricular Office for the student's file.

Verifying the arrival dates is difficult for the ET because there is no direct resource to compare against the admissions downloads. The usual resource is to call the registrar's office and compare or to get a print out which shows the discrepancies between

32

the SM Curricular Office database and the Registrar's database. The ET would really like to view (not update) the registrar's database. The ET does not know why the data from the admissions office is different from the data at the registrar's office. A suspected reason is that admissions has a problem with the quality of data input.

h. New Student Check-in

When new students report to the Naval Postgraduate School, various entities must provide or obtain information from them. If more than 100 students are reporting together, an "express" check-in is held in a lecture hall, and representatives from each entity process student information in sequence. If there are less than 100 students reporting, students are given a checklist when they report to the school quarter-deck and each student must visit each entity to exchange information. In both cases, entities collect the same information from students and maintain separate files and databases of identical information. Some of the forms filled out by students when they arrive are found in Appendix A. A flow chart of this process is found in Appendix B.

i. Provide Information to Students

One of the primary duties of the Curricular Office is to provide students with information. The Curricular Office maintains copies of all instructions and notices for reference by staff or students, and issues copies of the NPS Student Handbook and Thesis Preparation Manual to all students. The office also makes students aware of events such as routine drug tests and mandatory guest lectures via general voicemail messages and a large whiteboard located outside of the office. The general voicemail is difficult to access in the mornings, because more than 400 students are trying to call the same number.

j. Student Files

After assigning a matrix to an incoming student, the ET creates a file folder for each new student. These hard-copy student files contain:

- current NPS transcripts and undergraduate education transcripts
- copies of orders to/from NPS

33

- officer data card with photo
- copies of all correspondence relating to the student's academic performance, (i.e.: academic deficiency reports, Letters of Commendation, awards received at graduation, etc.)
- title and abstract of thesis

Files of current students are in a filing cabinet, but other files are kept separate:

- students who will be graduating
- students who have graduated but are on a thesis extension
- students who have orders to the school but have not yet arrived.

The files of students who have graduated are boxed up and placed in storage. The ET destroys records after 3 years. These records are maintained because they contain information not held by official registrar records which may be beneficial for later inquiries- further extensions to thesis time, graduate's qualifications for certain subspecialty-related billets, etc.

Preparing these files for storage is a time-consuming task, mostly because labels have to be typed for them- the Focus database "Print Label" function does not work. This discrepancy affects other ET duties, such as mailing diplomas. Other entities at the school, such as the Family Services Office, frequently request mailing lists from the curricular offices, and these must be prepared by hand.

D. INTERVIEW HIGHLIGHTS

The Systems Management Curricular Officer recommended reading several documents in preparation for interviews - the Academic Council Policy Manuel, Focus Database User Manual, the Faculty Handbook, the Curricular Office Handbook, and the Student Handbook. The curricular office Educational Technician had to search to find spare copies of these documents and the Academic Policy Manual found was a year older (1994) than the Curricular Officer's 1995 version.

During the interview with the SM Curricular Office Education Technician, one of the assistant curricular officers interrupted because of an urgent call received for a student. The student had a completed locator (see Appendix A) card and the assistant curricular officer went to the classroom specified. No one was there. The officer wanted to verify the card against the ET's student schedule printout. They matched, so the officer searched the entire building to find where the class had moved. According to the ET, the curricular office staff sometimes spends a lot of time looking for students.

E. ANALYSIS CONCLUSIONS

An Intranet applied to the processes of the Systems Management Curricular Office has the potential to provide easier and less expensive information distribution and retrieval.

Printing costs can be saved by providing the Student Handbook, NPS instructions and notices, etc. on-line. On-line publishing of school documents also solves the version management problem which was encountered in the curricular office. Rather than using a general voicemail message for daily events, students could listen to a digital voice file via a web browser, which would eliminate the congestion of the telephone voice mail. Grade summaries could be available to students on-line as well as to academic associates, who could execute automated queries to easily determine who is deficient in grades or overall academic standing. Grade summaries and schedules wouldn't need to be printed. If a student wanted a printout of his schedule, he could print it himself. Students could know which textbooks that they need as soon as they get their schedules. If a course changes locations or meeting times, professors or section leaders could easily update the information.

But perhaps more important than print cost savings is the tremendous potential for time savings. The important question is not what kind of content can be provided to the student, a more relevant question is what kind of content can be provided to the curricular office staff? Information provided to students is mostly static. Information provided to the curricular office by students requires considerable data re-entry by the education technician. If these processes were moved to a Web-based intranet environment where

35

students could enter the data themselves, the ET would be spared much time required for data entry and would be able to concentrate on database management and quickly responding to student needs.

Connecting the intranet to databases enables the right people to efficiently obtain or provide useful information. The Focus database currently in use does not have the proper functions to provide required information. If an NPS intranet is to achieve real utility, Focus must be replaced by a more functional relational database.

IV. PROCESS ANALYSIS

The processes of the SM Curricular Office described in the preceding chapter must be evaluated to determine which ones are best suited for intranet implementation. Some processes may be inappropriate for automation and only a limited number of processes can be modeled as intranet applications (for the purposes of this thesis) due to time constraints.

Each process was evaluated with the same criteria, and a ranking was established to show which applications would have the greatest impact if implemented. The top ranked processes were selected for prototyping.

A. ANALYSIS

The processes were evaluated by asking the following questions of each process:

- what entities are affected by this process?
- what is the number of users?
- who is the primary owner of the process?
- How often is the process executed? (e.g. daily, weekly, quarterly, annually)
- How often is the information updated?
- What is the mode of use by entities?

  -single update, single query

  -single update, multiple query

  -multiple update, single query

  -multiple update, multiple query

- What type of information is involved?

  -generic vs. customized

  -privacy vs. non-privacy

  -classified vs. non-classified

- What is the source of the information?

37

-manuals, databases, reports, letters, memos, etc.

- What is the current status?

   -already on the intranet, manual, partly automated, or fully automated

- What other relevant information applies?

The evaluation for each process is in the form of a table.

1. Add-drop courses

entities affected	students, academic associates, faculty, education tech.
number of users	all students (300 for SM)
primary owner	curricular office
freq. of use	quarterly
freq. of update	quarterly
mode of use	multiple update
information type	customized-tailored to individual student matrix
	privacy-student SSN on each report
information source	student
current status	manual paper-based system
other information	HEAVY data entry load on education tech.

2. Preregistration

entities affected	students, education tech., registrar
number of users	all students in SM (400+)
primary owner	curricular officer
freq. of use	quarterly
freq. of update	quarterly
mode of use	multiple query, multiple update
information type	customized
information source	database, students

current status	partly automated - database and printouts used
other information	Heavy data entry load for education tech.

3. Students Take Courses

entities affected	students, faculty, Registrar
number of users	all students (400+ in SM, 2000+ in NPS)
primary owner	Registrar, faculty
freq. of use	quarterly-final grades are a quarterly event
	daily-students and faculty interface daily
freq. of update	quarterly-final grades updated every quarter
	daily-students access course material on a daily basis
mode of use	multiple query, multiple update
information type	customized for each class
	privacy-student grades
information source	faculty
current status	partly automated... a paper based system but grades reside in a database
other information	registrar does dual validation- instructors confirm students and students confirm courses

4. Matrix Management

entities affected	students, academic associate, education tech.
number of users	all students (400+ in SM, 2000+ at NPS)
primary owner	curricular office
freq. of use	quarterly
freq. of update	quarterly
mode of use	multiple query, multiple update
information type	customized
information	students, course catalog, academic associate

39

source

current status manual, paper-based process which is input to a database

other information academic associates cannot see matrix of student needing advice on demand

5. Base Matrix Management

entities affected curricular officer, academic associate, education tech.

number of users 3

primary owner curricular office

freq. of use intermittent, unpredictable

freq. of update intermittent, unpredictable

mode of use multiple update

information type generic

information curricular officer, academic associate, curricular sponsor

source

current status partly automated

other information education tech. must update several sources when matrix changes. Cannot make changes which affect an entire section

6. Provide Information to Students

entities affected students, curricular office

number of users 400+

primary owner curricular office

freq. of use daily

freq. of update daily

mode of use multiple query

information type generic

information manuals, printed material, events calendar

source

current status partly automated-student kiosk & voicemail

7. New Student Preprocessing

entities affected	curricular office education tech
number of users	1
primary owner	curricular office
freq. of use	daily quarterly
freq. of update	daily
mode of use	single query, single update
information type	privacy-student SSNs
information source	admissions office
current status	partly automated-database w/ manual validation
other information	if the database could easily allow updates, the education tech. would not need to be overly concerned with validating info from admissions office.

8. New Student Check-in

entities affected	students, curricular office, Registrar's office, all others that use student data
number of users	throughout NPS: approximately 550 new students per quarter
primary owner	Dean of Students
freq. of use	quarterly
freq. of update	quarterly
mode of use	multiple query, multiple update
information type	generic, customized, privacy
information source	students
current status	manual, paper-based system of forms which are filed or retyped into databases
other information	at check-in, various entities request the same data from students over and over again, then enter data into duplicate databases

B. ANALYSIS AND CONCLUSIONS

In each process analysis above, the 'number of users' category offers numbers for students in both Systems Management and NPS. Most of the student management functions performed by SM are in place throughout NPS and although the processes are examined at the curricular office level in this thesis, the most value of an intranet at NPS lies in providing enterprise-wide access to applications which are used by all students. The analysis in Chapter Three indicated that a large amount of data entry time could be saved in the SM Curricular Office. All students must pre-register, for example, and all of the data is entered into Focus via all of the campus education technicians.

All of the above processes are suitable for implementing on an intranet. The processes chosen for prototyping are those which have the greatest impact. The quarterly academic scheduling process and add-drop process impose a heavy data entry load on the education technician and relieving this bottleneck in the curricular offices would result in great efficiencies. The new student check-in process was also selected for prototyping, because of the potential for eliminating redundant data entry and maintenance. Additionally, the redundancy and inefficiency which students encounter during the check-in process gives a negative first impression the Naval Postgraduate School, which is considered one of the U.S. Navy's primary high-technology research sources.

V. PROTOTYPE

A. RAPID APPLICATION DEVELOPMENT

The Rapid Application Development (RAD) methodology was used to approach the problem of creating an intranet for the SM Curricular Office. RAD is a user driven business model application development methodology which uses iterative prototyping to capture user requirements and data to meet real business needs. [32]

The RAD approach provides a means for more accurately capturing user requirements and developing systems more quickly than the traditional software development life cycle (SDLC). SDLC has several phases; determining requirements, systems analysis and design, building, testing, implementing, and maintenance. These phases try to capture the functionality of a system in a single, complex process. [34] RAD utilizes interviews and user workshops to capture requirements and evolutionary prototypes are developed in a iterative process which includes refining data models, process models, and object models. This process is usually supported by one or more visual programming tools which provides an integrated development environment (IDE) that supports modeling, prototyping, and code reusability.[33]

The prototype developed for the SM Curricular Office intranet is a "selected features" prototype, which is a prototype concept concerned with building an operational model which includes some, but not all of the features of a final system. An analogy is a new shopping mall which opens for business when some stores are not yet completed. [34] The SM intranet will incorporate only a few of the processes analyzed.

B. DEVELOPMENT TOOL SELECTION

Prior to any intranet application development, a web server, HTML editor, database, and CGI scripting tool had to be selected. Website Pro™ by O'Reilly and Associates was selected as a web server because it is one of the easiest to configure and

43

comes bundled with other helpful tools, such as the popular Hot Dog™ HTML editor, an image map editor, and a popular CGI scripting tool called Cold Fusion™ by Allaire.

In addition to Cold Fusion, three other CGI scripting tools for creating forms were sampled: Borland's Delphi™ with a third party add-on called WebHub, Borland's Intrabuilder javascripting tool, and Microsoft's ActiveX control pad. Intrabuilder (IB) was selected because of it's easy-to-use visual programming interface and easy integration with most relational databases. The Enterprise edition of Intrabuilder came bundled with Borland's web server, Netscape Navigator Gold Browser, and Borland's Interbase SQL server. IB uses Javascript which is augmented by some proprietary Borland extensions and is executed on the server-side rather than the client-side. A key factor in choosing the Intrabuilder tool was that the Naval Postgraduate School already had purchased a multi-user site license, and it provided the best IDE. The Website web server was already in use when Intrabuilder was selected, so the Borland web server was not used. IB interfaced seamlessly with the Website server. The Hot Dog editor was used as the HTML editor and Interbase as the database.

C. DATABASE

To create the database, a semantic object model was created from the analysis of the SM Curricular Office processes. A semantic object is a collection of attributes which represents an entity in a user's work environment. It is named to distinguish it from other objects and to correspond with the attributes that it represents.[7] The semantic objects initially identified in the curricular office are STUDENT, STUDENT MATRIX, CURRICULUM, DEPARTMENT, COURSES, CLASSES, and CODES.

The semantic object model was translated into tables for the relational database and created using the Interbase SQL editor. Appendix D contains the table structures. The database was lightly populated with several records for testing the applications which would interface with the database.

44

D. INTERACTIVE WEB APPLICATIONS

As previously stated, the greatest value of an intranet for the SM Curricular Office is the ability to obtain information from students, rather than providing it to them. The applications which are described in this section are the utilities for extracting the information.

1. Student Pre-registration

All students must pre-register for courses for the next quarter. When this application is requested, the student enters his curriculum number and Social Security Number to access his record in the database. The courses from the student's base matrix are displayed in textboxes and the student can edit them if he desires changing or adding courses. Six textboxes are displayed, meaning that a student can sign up for no more than six courses in a quarter. Below the textboxes is a link to the online course catalog which is maintained by the Registrar Office. If a student is confused about a course, he can browse the catalog without terminating his pre-registration session. The "save" button at the bottom of the form updates the student's course matrix with the changes which he has just typed, closes the form, and creates an onscreen report which summarizes the courses for which the student is pre-registered and lists the course lecture and lab hours.

2. Add/Drop Courses

This application allows a student to add or drop courses after the beginning of a quarter. The student enters his curriculum number and SSN on the first page and the application reads the courses to which the student is assigned. The second page is the course drop page and the courses are listed in six drop-down boxes. The student selects which courses that he wants to drop (or none) and clicks on the "next" button at the bottom of the page. The third page is the add course page which enables the student to enter course codes and segments numbers of courses which he wants to add. At the bottom of this page is another "next" button which enters the add and drop information into a special table in the database and creates a report which contains basic information

45

about the student and the add-drop information just entered. The report resembles the paper form which students currently use for course add/drop. This report is printed and routed for the appropriate approval signatures, then submitted to the education technician. Upon receipt of the approved form, the ET can update the student's matrix with the information contained in the special database table.

3. New Student Check-in

New students will interact with this application to provide their personal data such as home address and dependent data and special information which is requested only once upon arrival by various entities such as the Family Service Center, Security Manager, and Chaplain. It also provides useful information to students regarding library services, medical, dental etc.

E. STATIC WEB PAGES

Students must be able to find the applications and information on the intranet. To facilitate navigation, static web pages were designed to provide a hierarchy which allows easy drill-down navigation of information for students.

1. Opening Page

The opening page (fig 5.1) of the Naval Postgraduate School intranet would serve all personnel, not just students. The opening page provides access to all groups and information which is relevant for everyone.

The page design used is one which seems to be the most functional and very popular at many World Wide Web sites. A "header" or "banner" across the top of the page provides a simple description of your location and usually contains an image map which links to very general information about the site. A "sidebar" provides access to utilities or more specific information about products, services or entities. A "speed bar", usually at the bottom or top of the page, provides quick access to often used locations or utilities for people who know where they want to go. The open area in the middle and left
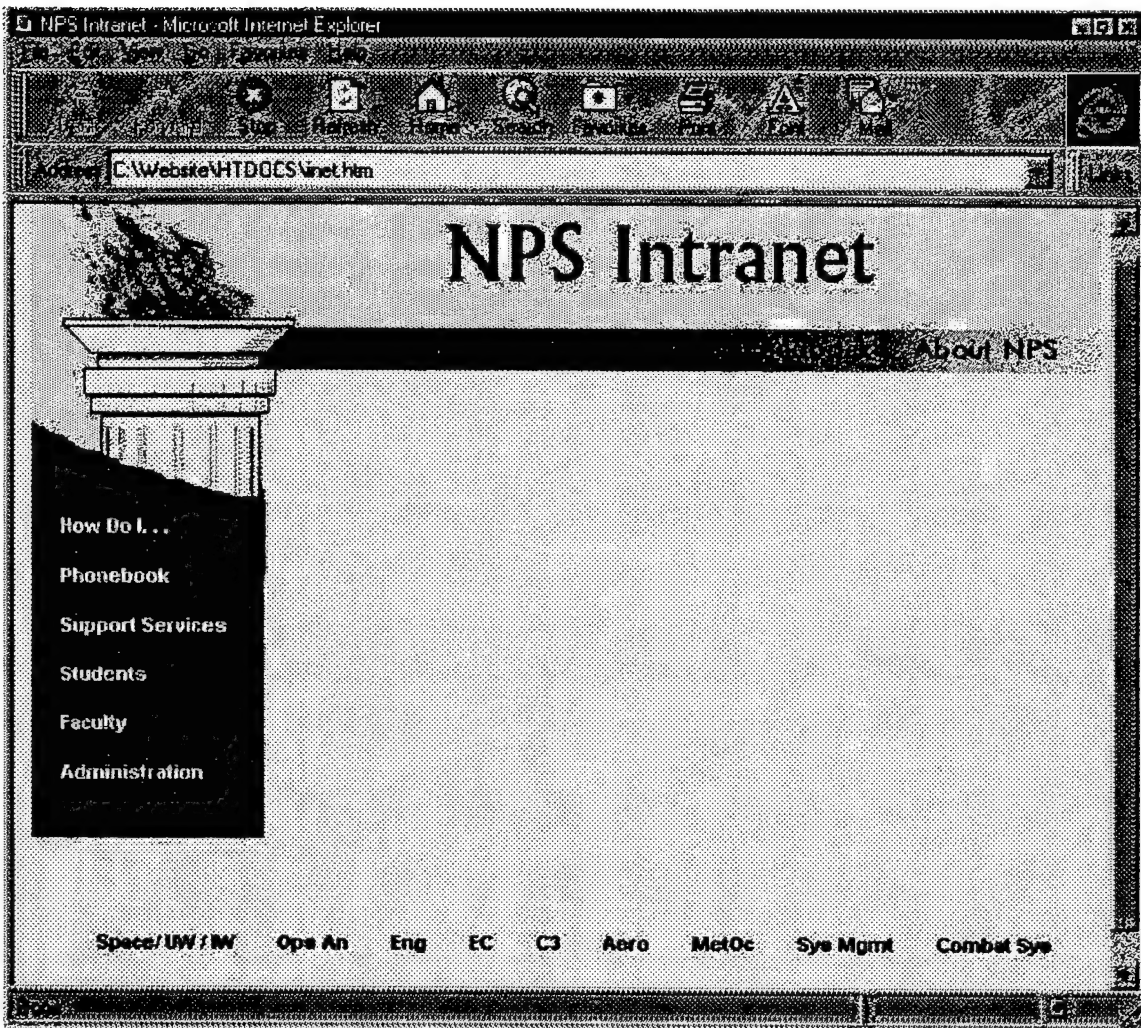
Figure 5.1. NPS Intranet Homepage

side of the page is used to display volatile information which changes frequently, such as news and upcoming events. Added graphics can provide a pleasing or professional look.

The NPS intranet page header contains a navigation bar which provides access generally useful information, such as a map of the intranet, a search utility, an intranet guided tour for newcomers, a feedback utility to provide comments about the intranet, and an area which provides directions on how to get to NPS, a map of the area, and other general information.

The sidebar provides links to utilities and web pages which serve specific entities at the school. The utilities include "How do I..." which describes functionality of utilities

locating personnel, office locations, and telephone numbers. "Support services" is a link to a page which provides access to the various customer service entities at the school, such as the Family Services Office, Human Resources Office, etc. "Student", "Faculty", and "Administration" link to pages which serve each of those groups.

The open area will be used to post "all hands" general announcements and news. The page graphics is a rendition of one of the oldest and best known lighthouses in ancient history, the Pharos of Egypt. This also ties well with the "flame of knowledge" symbology which is used in the present NPS emblem. The graphics are an attempt to capture the essence of the NPS organization into one or a few icons.

2. Student Page

The NPS intranet page for students (fig. 5.2) uses the same header, speed bar, and graphics, but a different sidebar. The student sidebar is split into two sections; the upper section provides links to interactive utilities such as course registration and add/drop courses, and the lower section links to collections of static pages which are used as references, such as the course catalog and thesis preparation manual.
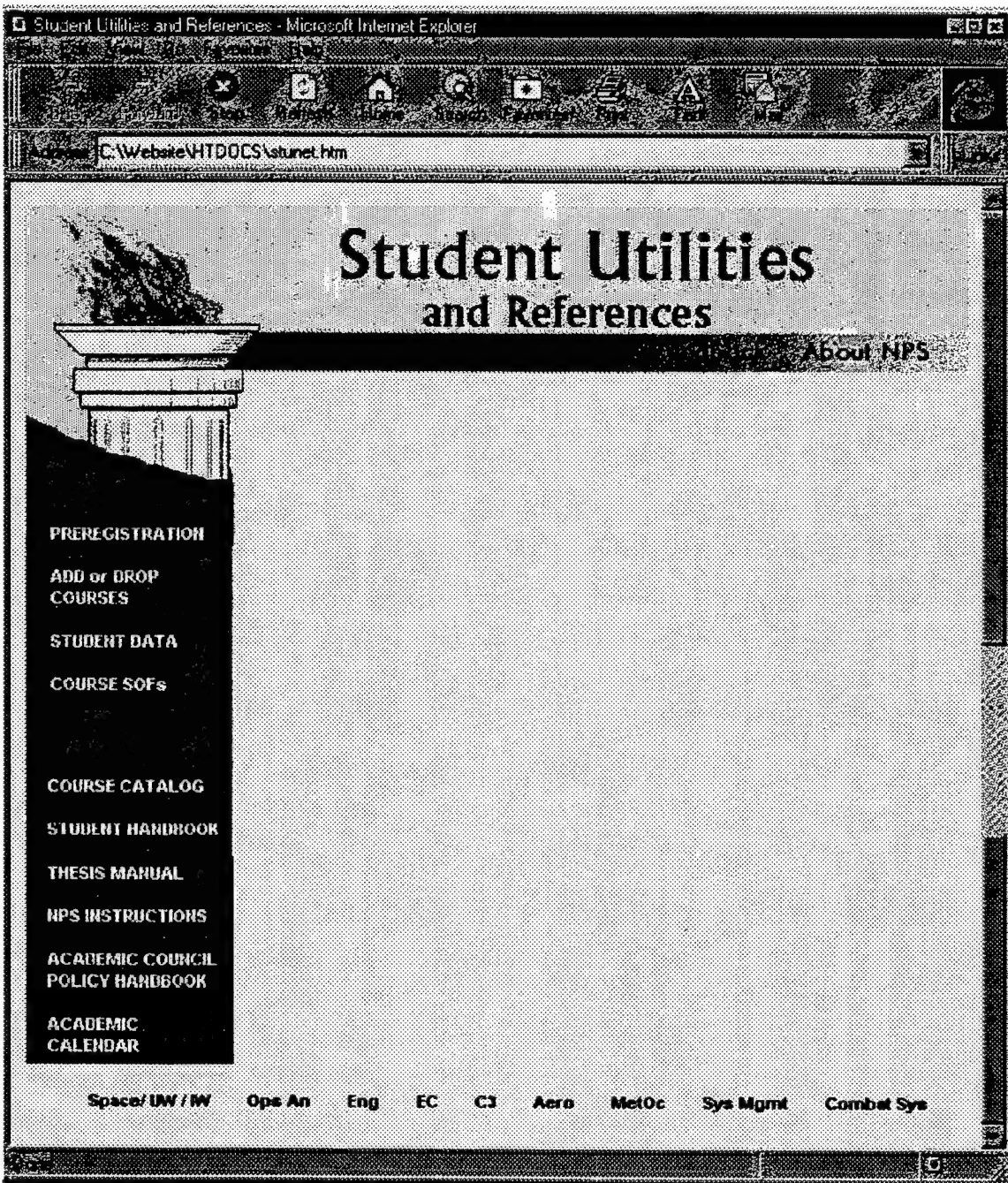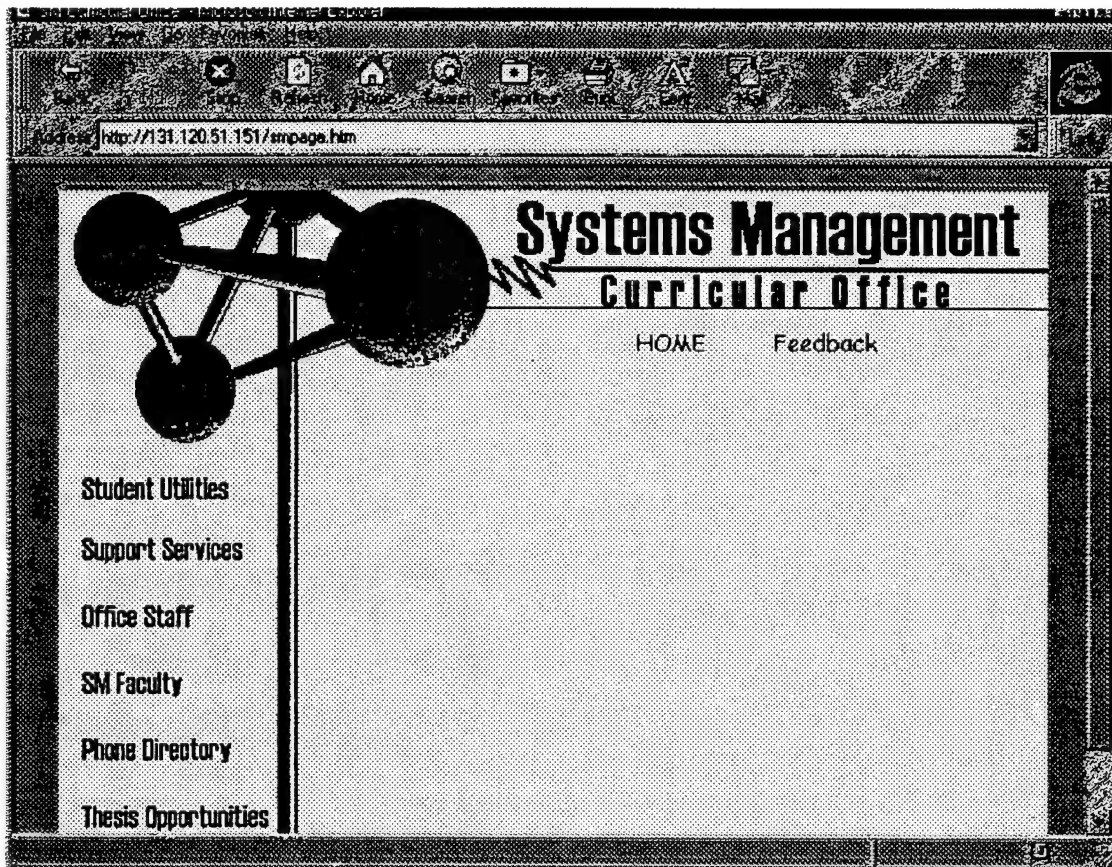
Figure 5.2. NPS Intranet Student Page

Figure 5.3. SM Intranet Page

3. SM Curricular Office page

The Systems Management intranet page (fig. 5.3) will be used to promulgate information to students. The large open area will be used like the white board outside of the curricular office. Persons who need to contact the education technician, urinalysis notifications, etc will be posted here by the Curricular Office staff. The title bar has a "home link to the NPS intranet main page, and the sidebar links to useful student areas such as the student intranet page described in the previous section, thesis opportunities which are provided in the SM department, the faculty, and the phone directory.

VI. IMPLEMENTATION ISSUES

A. CRITICAL SUCCESS FACTORS

All intranets are not the same. How do you measure them? Some are grass roots developments which only sponsor static web pages and others use interactive pages to provide access to enterprise-wide data. The following scale is a useful tool for understanding the various stages of development that an intranet might achieve [35].

    0 = No intranet

    1 = Department/Group information available on static web pages

    2 = Enterprise information available on static web pages

    3 = Department/Group information available via dynamic web pages

    4 = Limited Enterprise information available via dynamic web pages

    5 = Enterprise information available via an Enterprise maintained relational DBMS

Lower levels of intranet implementation can be achieved with a grass roots implementation, but achieving higher levels requires additional resources which require executive level support. As with any development project, the level of support is a critical success factor in an effective implementation effort. A good intranet strategy focuses on garnering support from upper and lower levels of an organization. Other critical success factors include a reliable network and a culture which embraces new technologies and information sharing. [2, 35]

B. INTRANET IMPLEMENTATION STRATEGY

1. Analyze Culture

A culture of open information sharing is necessary for an intranet to achieve its maximum potential. If departments have databases that isolate information needed by

51

other departments, then an organization can only achieve a level 3 implementation. [35] If the users in the organization are entrenched in established business practices and fear changes that an intranet can bring, the intranet will not succeed. [36]

An intranet for the SM Curricular Office will have no cultural problems. The student population at the Naval Postgraduate School are military officers who are accustomed to embracing new technologies which enable an organization to become more efficient. They will also use whatever means are made available to them to accomplish a task. If students are told by their leadership to begin using an intranet for administrative tasks such as pre-registration and adding or dropping courses, the students will use the intranet. Other groups on campus such as faculty or staff civilians do not have the flexibility of the student population and may be more difficult to migrate to intranet applications for administrative functions.

Focusing an intranet development at the level of a department or curricular office may lead to redundancy of effort and a level 3 implementation. If every curricular office created interactive web pages which allows students to pre-register for classes, the same application would be designed many different ways. Applications which are used by large groups across department boundaries should be developed and administered by a central entity, such as the Computing and Information Services Department, to promote a more enterprise-wide use of information. A central hierarchy of web pages must also be created to provide enterprise-wide access to all of the information provided by various entities. Therefore, the remainder of this chapter considers the implementation of an intranet for the entire Naval Postgraduate School, and how the Systems Management Curricular Office would be part of that development.

2. Analyze Existing Network and Software Requirements

A reliable network with adequate bandwidth and TCP/IP is necessary for an intranet to provide enterprise-wide access to enterprise data [2, 35, 36]. Web Servers in any part of the network must be visible to other parts of the network, unless kept separate for security reasons. Other critical equipment are web server software, browser software, a relational database management system (RDBMS), and authoring software which helps

create both static web pages and dynamic pages which access databases. The Naval Postgraduate School is presently in the process of upgrading it's network to provide more bandwidth, a network standard, and better service. Reliability is paramount if mission-critical applications such as student pre-registration are to migrate to the network. The NPS network already supports TCP/IP.

3. Create a Core Implementation Team

A central group must exist to control the intranet implementation. This group must be skilled in systems analysis and design, web page design, database management, and the use of web authoring tool to create static and dynamic pages. This group will determine standards such as what web servers and browsers should be used and provide a hierarchy of web pages which will provide access to all of the information available on the intranet in a coherent manner. People skills are also important, as this group will be interfacing with many other parts of the organization throughout the implementation. [2] At the Naval Postgraduate School, this core group would consist of people from the Computing and Information Services Department, such as the NPS webmaster, database administrator, and one or two application programmers. The core group will manage and provide access to web servers, as well as helping information providers develop content for the intranet.

4. Create Useful Static Content

Once the core team is created, they should first focus on creating some static web pages which provide real utility, such as publishing on the intranet instructions and notices which are used by everyone instead of spending time and money for printing and distribution. The main idea is to demonstrate immediate benefits, such as print cost savings. The development team should not provide this content, however. They should train those who are already providing that information. By enabling the information providers to create their own pages, the mechanism for *maintaining* information content will already be in place. [2] The development team will provide the web pages which will enable users to easily navigate to the information providers pages.

Many useful static web pages have already been created for the NPS World Wide Web site, and a primary task of a development team would be to provide an easy way to navigate and find information which already exists, as well as training content providers. The Systems Management Curricular Office is considered to be a content provider, and one or two individuals in that office would be trained on how to create pages to communicate specific SM Curricular Office information to students. If web pages already exist, such as the case at the Naval Postgraduate School, existing pages must be connected.

Unless the network requires a major overhaul, costs at this stage of an intranet development are low. Web Servers, browsers, and authoring tools are not expensive and the information providers were already engaged in publishing.

5. Build Support

When some useful static content has been created for an intranet, the development team must aggressively market the intranet to both users and management. As stated earlier, user support across an organization is vital to fully implementing an intranet. By demonstrating the power and immediate cost savings available to users, the intranet will sell itself and more content providers throughout the organization will begin publishing solely on the intranet. Executive levels of management must also support an intranet, because development costs rise steadily when developing applications which access enterprise data, as shown in the next section. The cost savings provided by intranet publishing should convince managers that an intranet is a worthwhile investment, but if it doesn't, developing one or two "killer apps" which provide enterprise-wide access to useful information may help. [2, 35, 36]

6. Create a "Killer App"

Applications which provide enterprise-wide access to data can boost employee productivity and efficiency. If managers do not accept the intranet concept at first, a "skunkworks" development of one or two initial database driven "killer" applications can be used to gain further user support. These are applications which are useful to large

groups of people, if not everyone. The pre-registration, add/drop courses, and new student check-in applications developed for this thesis are all examples of this kind of application. If user support of an intranet is broad enough, it will be impossible for managers to not support it. Management support will be required for fully implementing dynamic pages which connect to enterprise data. If a central database already exists, permission must be obtained to access data. If a central database does not exist, central management support will be required do obtain and develop one. If the development team does not have the programming skills to build interactive applications, they must be outsourced or acquired. If the skills are available for building applications internally, programmers must be made available, which means that management has set its priorities in support of an intranet. Acquiring and implementing a RDBMS and paying programmers for development and maintenance time can be very expensive. [2, 35]

At NPS, the hierarchical Focus database which is used by most departments must be replaced by a RDBMS. Acquiring this database, training its users and administrators, and creating web applications which interface with it will be the most expensive aspect of an intranet implementation.

7. Provide an Effective Management Structure

Policies must be established to deal with who can (and can't) publish and to determine how information is to be linked and indexed, as well as updated and/or deleted, or the intranet is likely become a totally unorganized tangle of largely unusable information.[36] As support for the intranet and the amount of information available continues to grow, the development team must begin to shift from implementation to management. Policies for publishing and security must be established and enforced. Configuration management and technical support must made available. Some organizations provide a service group which can provide web pages and database space based on a charge-back system. [2] Again, the Computing and Information Services Department at NPS is best qualified to fill the intranet management role.

8. Plan and Develop Other Applications

Developing interactive applications with full organization support marks the shift from a grassroots development effort using content providers to an enterprise wide effort to develop a full-blown information system which can support mission critical applications. [36]

C. RAD METHODOLOGY

The strategy presented above follows a RAD-like methodology. The intranet is built in steps which resemble iterative prototypes. The core team is a group of insiders from the organization who already have developed a sense of what users want.. The "build support" phase provides feedback from users, as well as attempting to garner additional support and resources for further development.

VII. CONCLUSION

A. LIMITATIONS OF PROTOTYPE

The prototype applications were developed over a three month period at the same time that the programming tools were being learned. The prototype applications have many flaws and limitations that should be corrected in the next iteration. The following are the known limitations of the prototype.

- The student Check-in application does not connect to a database. The SM Curricular Office uses only a small portion of the data which is collected during check-in, and an analysis of the processes and data which other entities use as a result of student check-in was not conducted.

- There is no way to return to the Student home page from the end of the pre-registration or the add/drop applications. Both end in reports which do not provide hyperlink capability. Users must back out of the applications.

- The Students static web page needs a link back to the NPS intranet home page.

- Although the prototype models activities which occur in every curricular office on campus, it is based on an analysis of Systems Management Curricular Office processes. Any attempt to implement the prototype on a school-wide basis would require analysis of other departments and their processes.

- Neither the pre-registration or add/drop applications change automatically to reflect the current quarter. "Summer 1997" quarter is coded into both applications.

- Limited test information exists in the database. Pre-registration and add/drop only work using the Information Technology Management curriculum and test SSNs 000000000, 000000001, and 000000002.

- The three static web pages provided in chapter 5 are only designs and do not function. The applications are accessed through a central page called "home.jfm".

- Error handling is not provided beyond operating system and database functions, which can result in cryptic error messages if a database parameter is not matched.

B. FUTURE ENHANCEMENTS

The first enhancement of the prototype would be to correct the deficiencies noted above. The second enhancement would be to provide some of the static material which would be useful to students and already exists in a digital format, such as the student handbook and thesis preparation manual. The application which have already been developed could be given some professional graphics to improve their appearance.

Other applications which would provide much benefit are those that would allow students to see their grades online and download a grade summary to their home directory or have it emailed to them. Academic Associates could run a report which would provide a list of all students with grades below a 'B', instead of having to print grade summaries for every student and screen them. The reports which the Education Technician prepares by hand could easily become automated. If someone in the Family Services Center needs an updated mailing list every three months, they could run a report to obtain it without calling other entities for inputs. Section leaders could change the meeting time and location of classes to reflect reality, so that finding students while they are in class becomes a simple matter. And if an intranet at NPS is expanded to include more than just students, the possibilities for future applications is tremendous.

58

C. LESSONS LEARNED

Development and Implementation of an intranet for the Systems Management Curricular Office alone should not be considered beyond the development of static web pages. Interactive intranet applications can definitely increase productivity and efficiency in the Systems Management Curricular Office, but because the processes that are used by SM to interface with students are the same processes which other departments use, the development and implementation of intranet applications to support these processes should be considered on a school-wide basis. For example, the pre-registration application should be developed and maintained by the Computing and Information Services Department and the data should be in a database which is also administered by them. Ensuring that students pre-register would be the responsibility of the Curricular Office and the pre-registration data entered by SM students should belong to SM for quality assurance and maintenance. Approaching the development of an intranet on a school-wide basis, as opposed to a department-wide basis, is the key to creating a useful and cost-effective intranet.

Rather than beginning with the most complex area of an intranet-dynamic pages connected to databases- an intranet development should begin with the "low-hanging fruit" which are the static pages that can be created from material which already exists in a digital format. After the easier static pages of an intranet are developed to provide some utility, then more complex projects can begin.

APPENDIX A. SAMPLES OF FORMS

NAME (Last, First, MI)			RANK/BRANCH	SGC NO.	CURR/DEPT CODE
DATE REPORTED	PRIOR DUTY STATION				DEPARTURE DATE
SPOUSE'S NAME	NUMBER OF CHILDREN	HOME ADDRESS (LOCAL)			PHONE NUMBER

CHAPLAIN'S INFORMATION
Optional - This information is used extensively by the command to serve you and your family members.

Please indicate (X) your Religious Preference and that of your spouse, if married.

Please indicate (X) any areas of service in which you would be willing to serve in our Chapel Program.

YOU	SPOUSE		YOU	SPOUSE	
__	__	CATHOLIC	__	__	ADULT STUDY GROUP
__	__	JEWISH	__	__	SUNDAY SCHOOL TEACHER
__	__	ORTHODOX	__	__	YOUTH GROUP LEADER
__	__	PROTESTANT	__	__	CHOIR MEMBER
(Give Denomination)			__	__	INSTRUMENTALIST
__	__	OTHER (Specify)	__	__	ADMINISTRATIVE WORKER

ADDITIONAL INFORMATION:

NAME   (LAST, FIRST, MIDDLE INIT.)   SGC #
RANK   SERVICE   CURRIC. OFF.   DATE SGC OPENED
DEPENDENTS NAMES
HOLDER OF SGC BOX UNDERSTANDS NPS POLICY REGARDING MAIL DELIVERY AND CRITERIA GOVERNING THE RECEIPT OF PERSONAL MAIL .
SIGN / DATE

Figure A-1. Chaplain's Information Form (top), Student Mail Center Form (bottom).

61

PERSONNEL SECURITY ACTION REQUEST

PART I - SUBJECT INFORMATION
(Items 1 Thru 8 must be completed for all requests)

1. Name (Last, First, Middle)	2. SSN	3. Grade/Rank	4. Designator/MOS/RATING
5. Status	6. Former Maiden Name/Aliases	7. Date of Birth (YYMMDD)	8. Place of Birth

(Items 9 thru 11 required when requesting SCI eligibility determination)

9. Date and Place of Current Marriage (YYMMDD)	10. Date and Place of Divorce (YYMMDD)

11. Citizenship of: a. Parents: _____   b. Brothers: _____   c. Sisters: _____

d. Spouse/Cohabitant: _____   e. Children: _____

PART II - LOCAL SECURITY REQUIREMENTS

12. U.S. Citizenship verified: YES / NO

13. Local Records Check Accomplished: Favorable/Unfavorable (ATTACH ANY UNFAVORABLE COMMENTS).

14. Subject has continuous service with no break greater than 24 months verified: YES / NO

PART III - NOTIFICATION OF COMMAND ACTION

15. Final / Interim / Top Secret / Secret / Confidential clearance granted IAW OPNAVINST 5510.1H requirements.

16. Personnel Security Investigation mailed to DIS on (YYMMDD): _____

17. Subject's clearance and access were administratively lowered without prejudice to: No Clearance / Confidential / Secret.

18. Suspended subject 's access for cause to: SCI Only/All Classified Information on (YYMMDD): _____   (ATTACH DETAILS)

19. Other:

PART IV - DONCAF ACTION REQUESTED

20. Determination Requested: Confidential / Secret / Top Secret / SCI Eligibility / TIS (YYMMDD)
    (CIVILIAN) Non-Critical Sensitive / Critical Sensitive / Special Sensitive

21. Other:

PART V - ADMINISTRATIVE

22. Remarks/Enclosures

23. Requesters Complete Mailing Address:	24. UIC/RUC/OPFAC (SUBMITTING): _____
	25. UIC/RUC/OPFAC (RETURN): _____
	26. NSG Asset: YES / NO

27. Date	28. Name, Grade/Rank, Title and DSN/Commercial Number	29. Signature

OPNAV 5510/413 (Rev. 1-94)   S/N 0107-LF-017-1300

Figure A-2. Security Manager Check-in Form.

NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA

STUDENT INFORMATION SHEET

OFFICIAL
PHOTO 1 3/4
BY 2 1/2

NAME_____
Last, first, middle

RANK _____

CURRIC #_____ SERVICE_____COUNTRY_____

SSN#_____SGC#_____PASSWORD_____
Voice mail (4 digits)

DATE AND PLACE OF BIRTH_____

DATE REPORTED TO NPS_____ GRADUATION DATE_____

ENDING DATE OF LAST FITREP_____

ADDRESS_____CITY_____

ZIP_____GOVERNMENT HOUSING Y/N____ PHONE NO._____

DATE OF RANK_____YR GROUP_____ DESIGNATOR/MOS_____

MARITAL STATUS M/S____ SPOUSE'S NAME_____ #OF CHILDREN___

If any of the information above changes during the time you are here, please notify the
curric office immediately.

Figure A-3. Curricular Office Check-in Form.

Dudley Knox Library

U.S. Naval Postgraduate School
Patron Information Form

☐ New Patron
☐ Update Patron

Title/Rank: _____ Name (Last name, First name): _____

Status:	Affiliation:			
☒ Student	☐ NPS	☐ MIIS	☐ CSUMB	☐ DRMI
☐ Faculty	☐ DLI	☐ CTB McG/H	☐ MOBAC	☐ DMDC
☐ Staff	☐ Retired Mil.			
☐ Other Specify: _____	☐ Other Specify: _____			

NPS Personnel Only:

UNIX Log-in: _____   Department: _____

Curriculum Code: _____   Graduation Date: _____

Complete ALL address sections and use the ☐ to indicate preferred address for notices

☐ Home Address:

    Street: _____

    City/State: _____ ZIP Code: _____

    Day Phone: _____ Home Phone: _____

☐ Business Address:

    Line 1: _____

    Line 2: _____

    Line 3: _____

    City/State: _____ ZIP Code: _____

    Attention: _____ _____ Work Phone: _____

    FAX: _____

☐ Other Information:

    Mail Code/SGC No.: _____

    Office Location (Building/Room): _____

    E-Mail Address: _____

Library Use Only:		
User ID: _____	Received (Date/By): _____	
Profile Name: _____	Entered (Date/By): _____	

D-2

Figure A-4. Library Check-in Form.

CHECK - IN SHEET

COMMAND SPONSOR PROGRAM

Name_____ Rank/Rate_____ Date_____

Dept/Curric_____ Branch of Service_____ SMC#_____

1. **Please circle one:** **Single** **Single Parent**
   Married, no children **Married with children**

2. **Were you assigned a sponsor? Yes__ No___**

3. **Did you receive a Welcome Packet prior to arriving in Monterey? Yes___ No___**
   If no, did you receive a Welcome packet prior to visiting the FSC? Yes___ No___
   (If you did not receive one, you may pick one up at FSC.)

4. **If there were extenuating circumstances impacting #2 or #3 above, please note:_____**
   _____

5. The Family Service Center can help you with information or assistance in the
following areas (please check those desired):

___Employment Assistance   ___Rentals

___Transition Assistance (Retiring/Separating)

___Child Care   ___CHAMPUS/TRICARE

___Dental Plan   ___Medical Services

___Volunteer Opportunities   ___Family Advocacy

___Counseling Services (Stress Management, Improved Communication)

___EFMP (Exceptional Family Member Program for special medical or
educational needs) If applicable, please complete questionnaire on reverse.

If you have a question and don't know where to start, try FSC! We are located in
1280 Leahy Rd, La Mesa Village our phone is 656-3060.

Figure A-5. Family Service Center Check-in Form Page 1.

EXCEPTIONAL FAMILY MEMBER PROGRAM (EFMP) QUESTIONNAIRE

1. Do you have any family members (dependents only) with any of the following conditions?

   ASTHMA/ALLERGY___   VISUAL IMPAIRMENT___

   HEARING IMPAIRMENT___   SEIZURES/EPILEPSY___

   MENTAL RETARDATION___   BEHAVIOR/EMOTIONAL PROBLEM___

   PHYSICAL HANDICAP___   LEARNING DISABILITY___

   SPEECH/LANGUAGE DEFICIT___

   ADAPTIVE EQUIPMENT (WHEELCHAIR/CRUTCHES/BRACE)___

2. Have you ever been or are you now enrolled in the EFM Program?

   Yes___   No___

3. Is your family member residing with you now and in need of treatment or assistance?   Yes___   No___

4. Name/relationship of family member needing care:

   Name_____   Age_____

   Relationship_____

5. EFMP Command POC at the Family Service Center (FSC) is Michael Cleary at 656-3488.   EFM sponsors, please call for an appointment.

6. EFMP Coordinator is HMC Sison, Navy Medical Administration unit, located at the   PRIMUS Clinic (POM), 242-5614/5615.

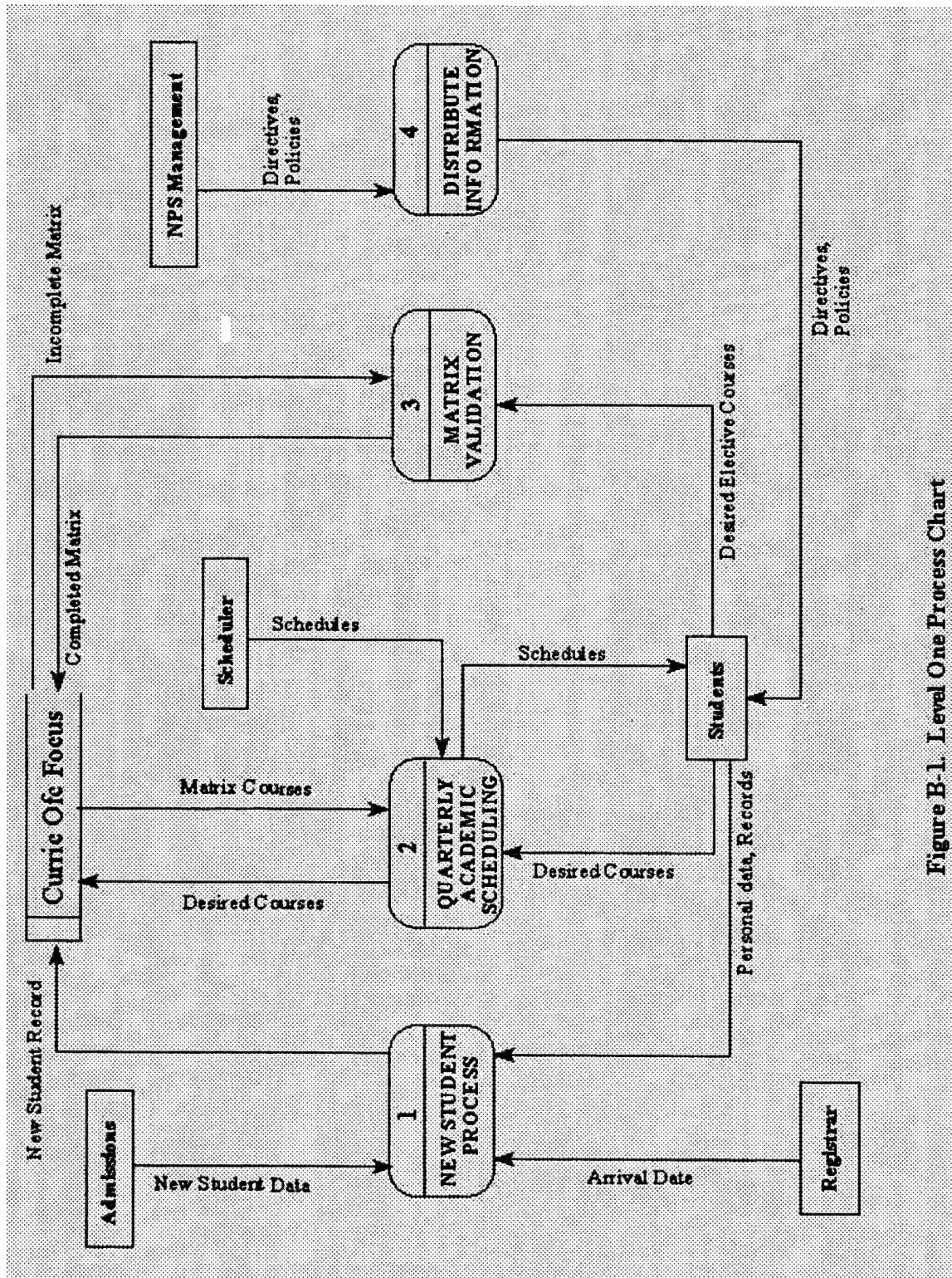**Figure A-6.** Family Service Center Check-in Form Page 2.

NAVAL POSTGRADUATE SCHOOL
OFFICE OF THE REGISTRAR

MONTEREY, CA 93943

REGISTRAR INFORMATION SHEET

(Please Print Legibly)

Enter your name as you would like it to appear on your Naval Postgraduate School transcript. Any name changes after submission of this form must be submitted to the Director of Programs for approval, via your Curriculum Officer.

_____   _____

Last Name   **First**   **Middle**   **Social Security Number**

Rank /Grade _____

Service _____

Designator (USN Only) _____

Student Mail Center Box No _____

Curriculum No _____

NAME OF SCHOOLS WHERE YOU WERE AWARDED DEGREES:

_____

Name of Institution, State   **Degree Rec'd/Major**   **Year Awarded**

_____

Name of Institution, State   **Degree Rec'd/Major**   **Year Awarded**

_____

Name of Institution, State   **Degree Rec'd/Major**   **Year Awarded**

Under the authority of 5 USC 301, the above information is to become a permanent part of your student record. The information provided will not be divulged without your written authorization to any one other than for official business with the appropriate agencies of your country or service.

SIGNATURE _____   **DATE** _____

REGISTRAR, CODE 61, X2592   REVISED JUNE 1995

Figure A-7. Registrar's Office Check-in Form.

APPENDIX B. PROCESS DIAGRAMS

Figure B-1. Level One Process Chart

69
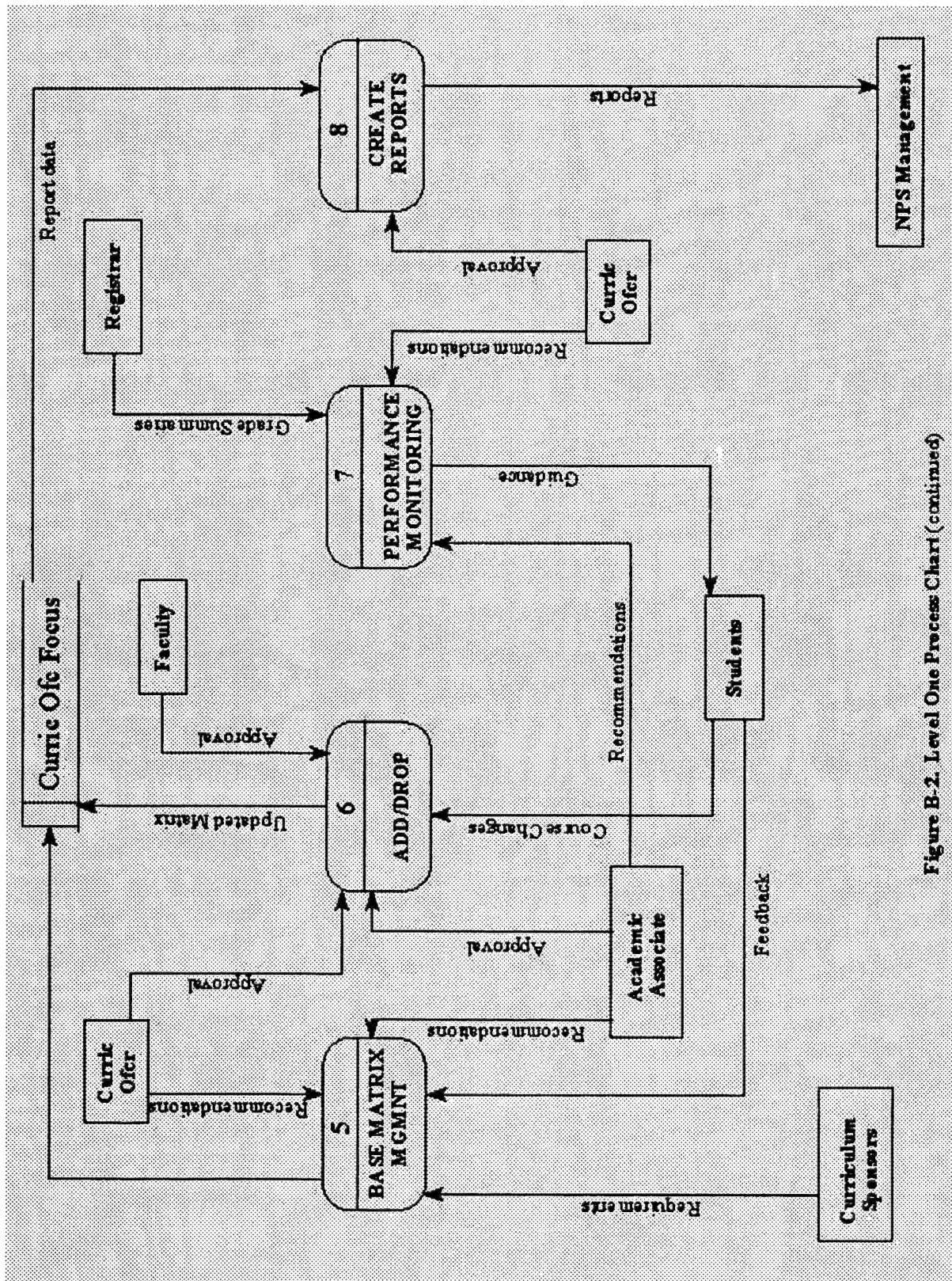
Figure B-2. Level One Process Chart (continued)

70
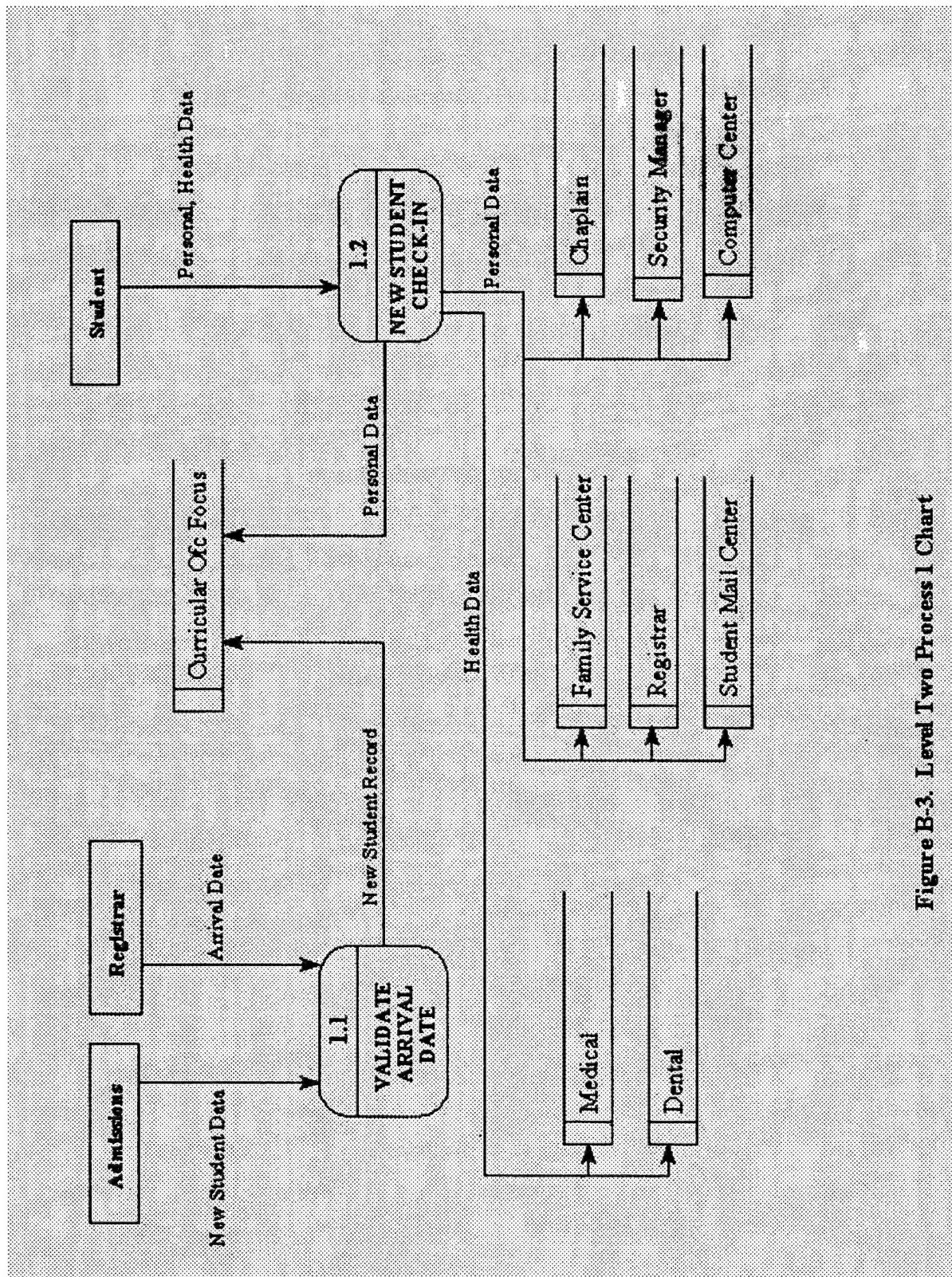
Figure B-3. Level Two Process 1 Chart

71
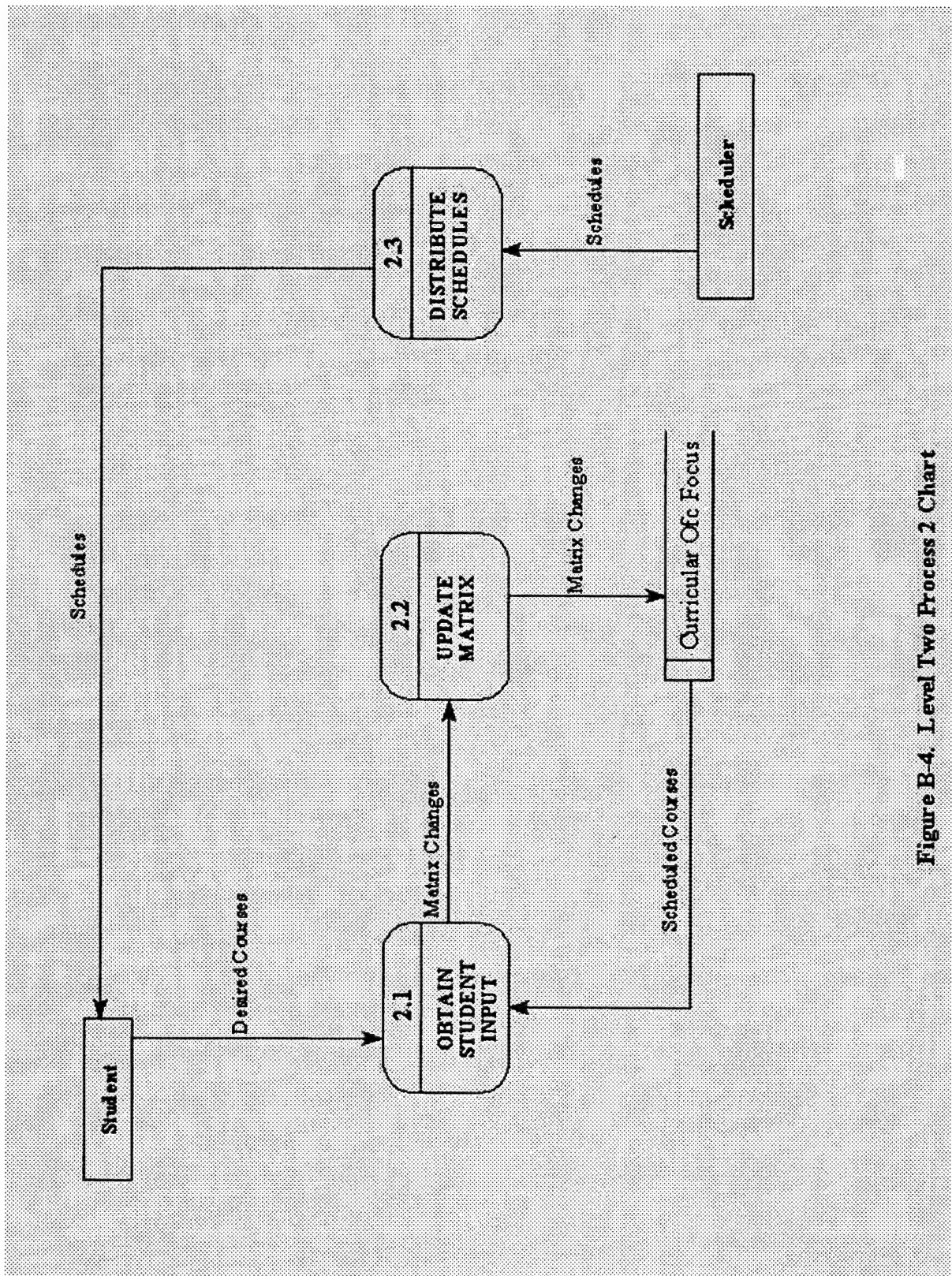
Figure B-4. Level Two Process 2 Chart
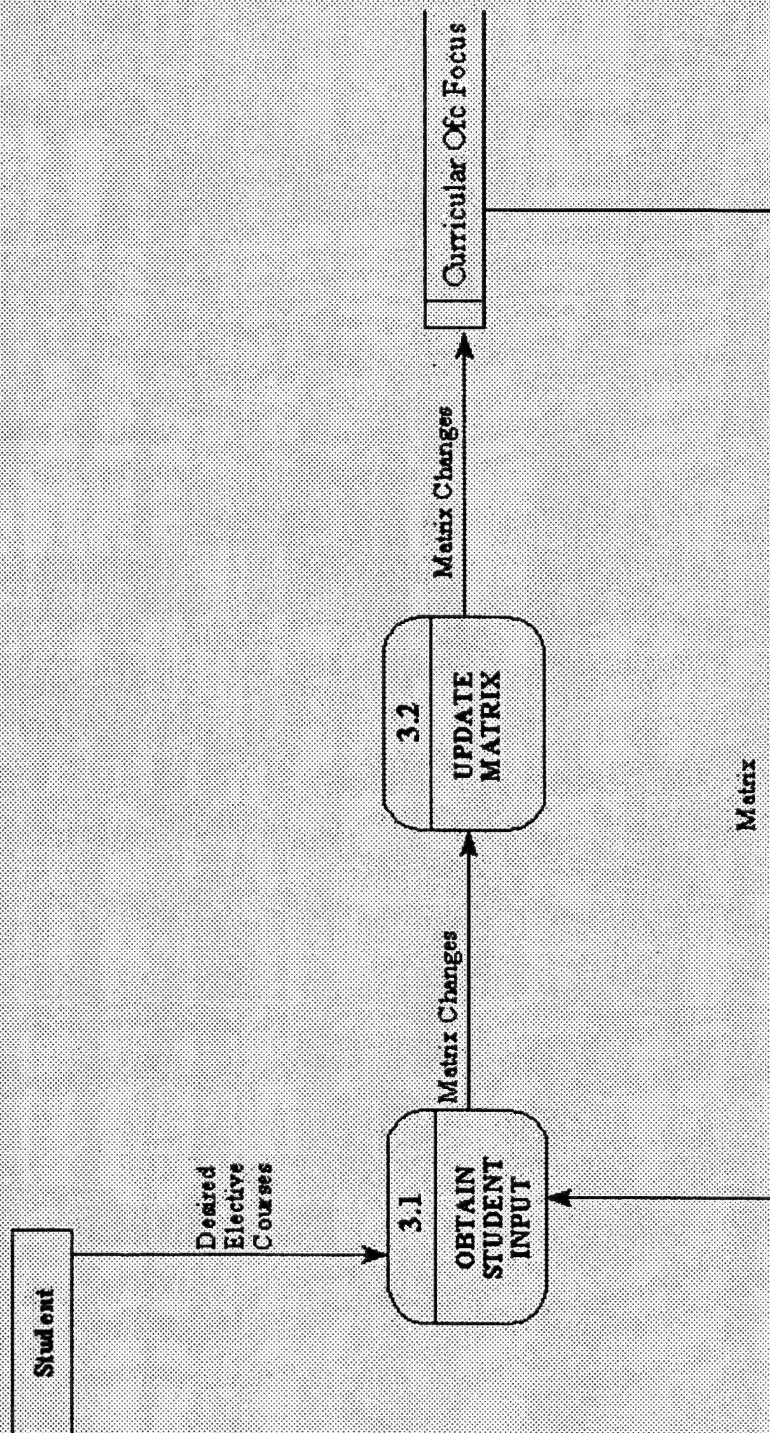
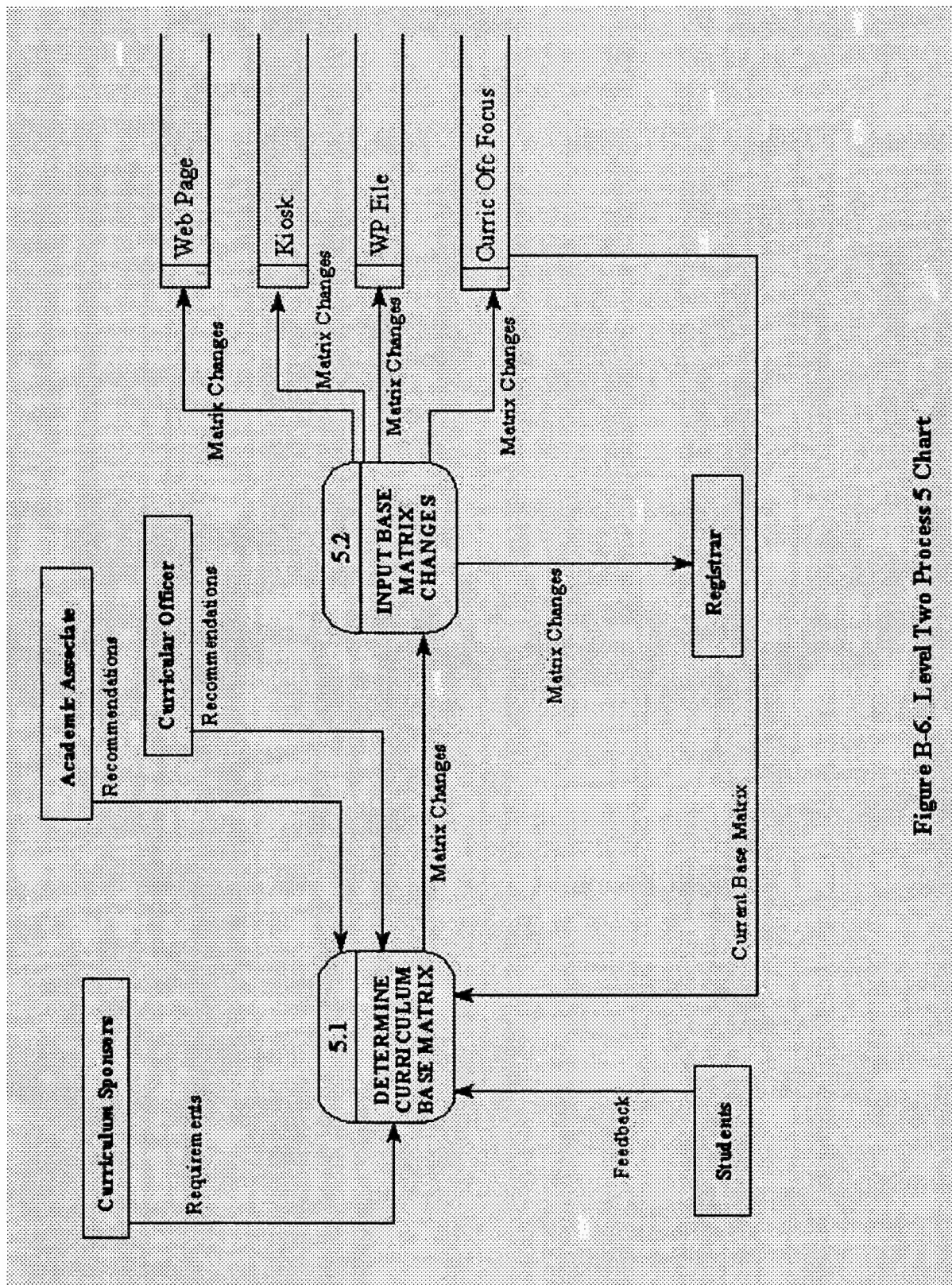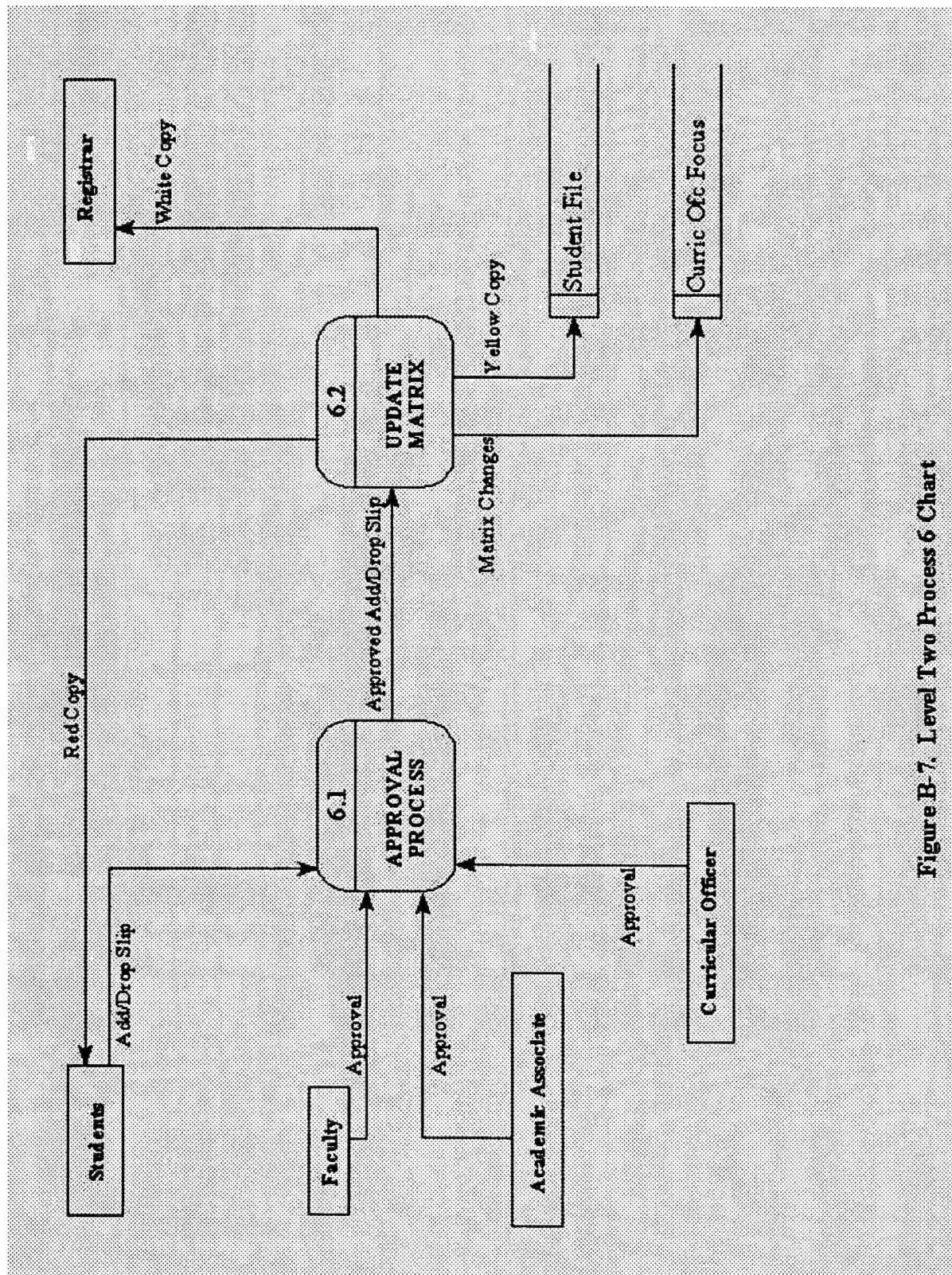Figure B-5. Level Two Process 3 Chart

73

Figure B-6. Level Two Process 5 Chart
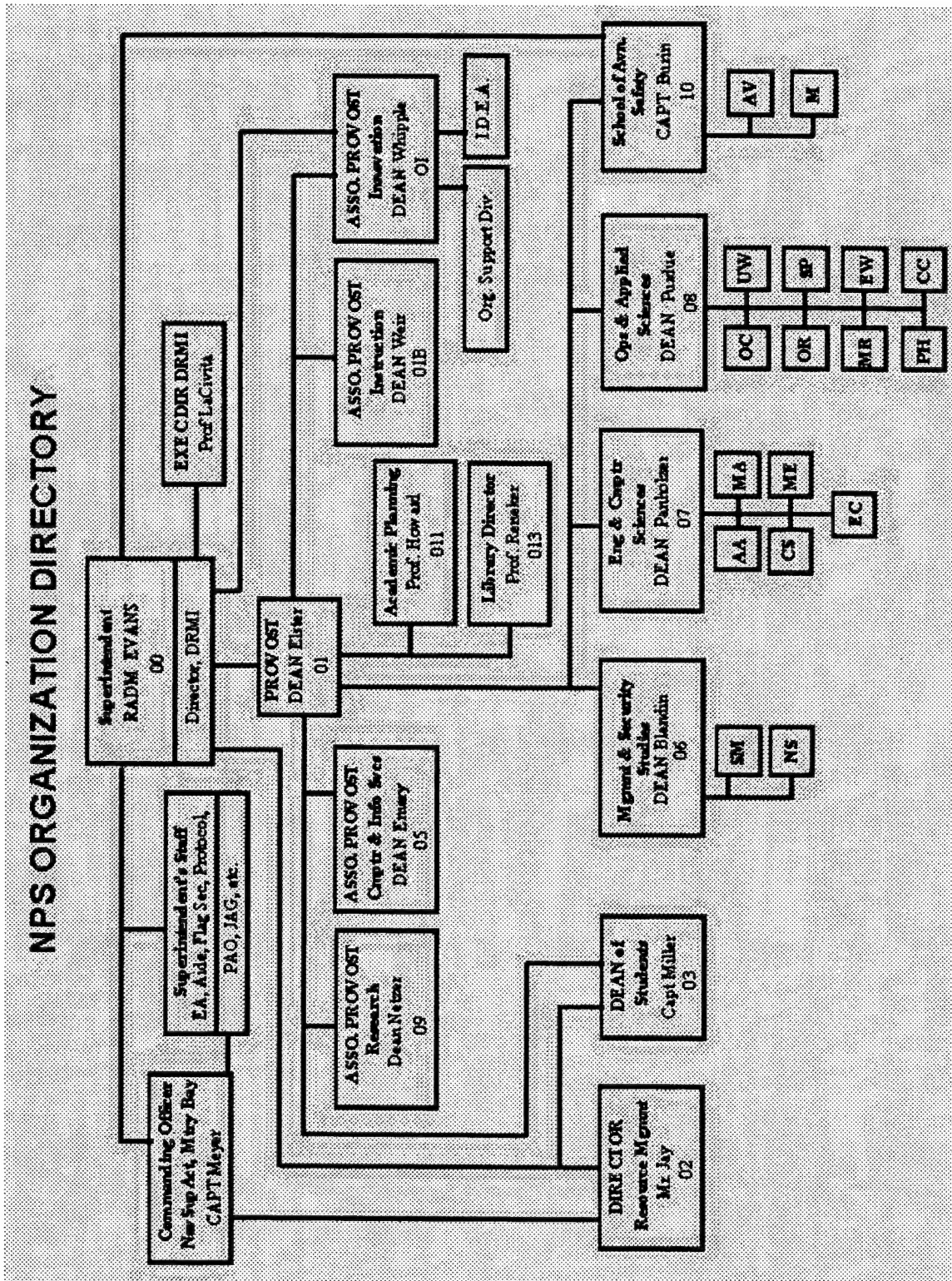
74

Figure B-7. Level Two Process 6 Chart
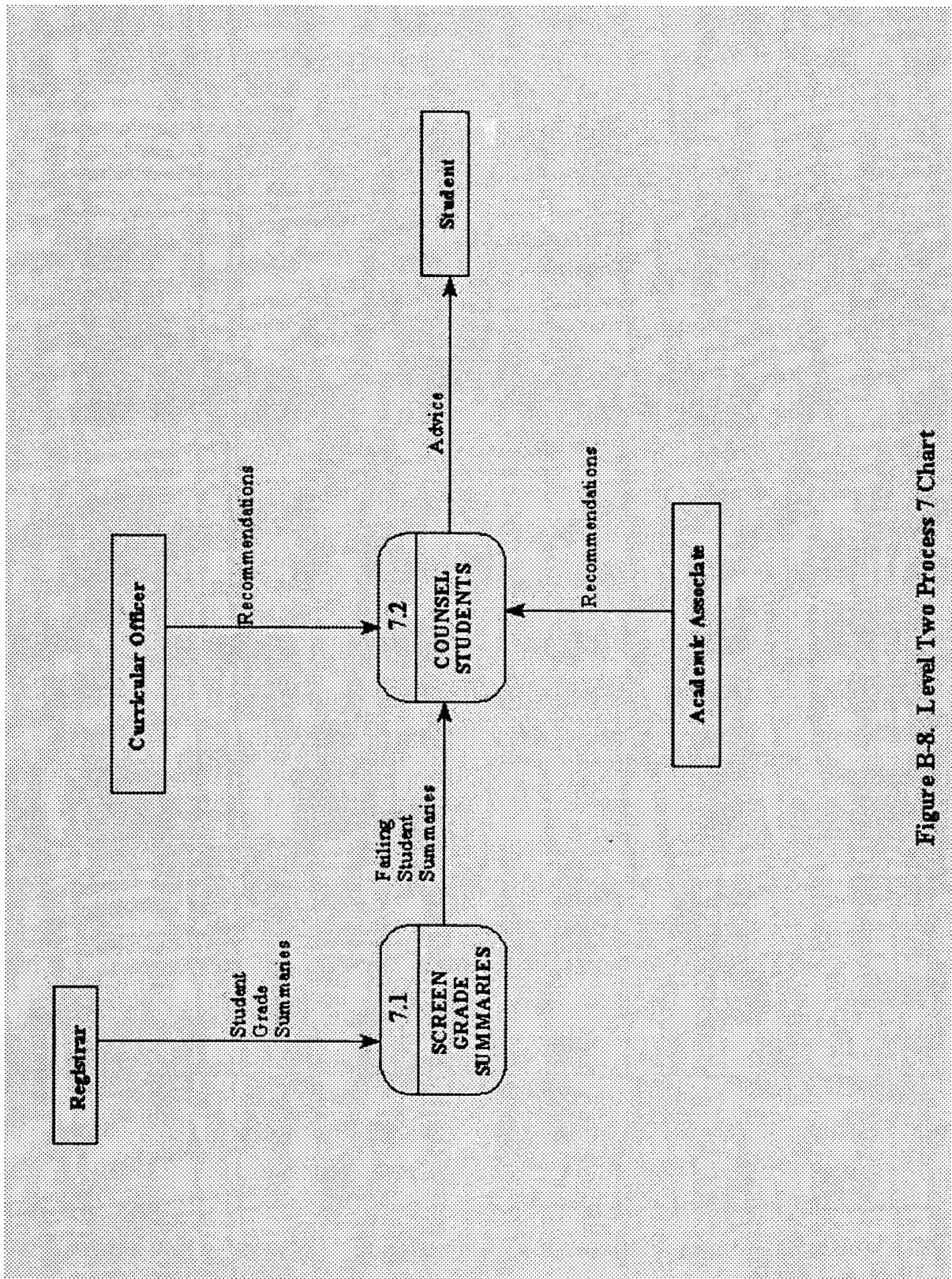
Figure B-8. Level Two Process 7 Chart

APPENDIX C. NPS ORGANIZATION CHART

NPS ORGANIZATION DIRECTORY

APPENDIX D. DATABASE STRUCTURE

/* Extract Database C:\Thesis\Data\Student.gdb */
CREATE DATABASE "C:\Thesis\Data\Student.gdb" PAGE_SIZE 1024 ;

/* Table: ADDDROP, Owner: SYSDBA */
CREATE TABLE ADDDROP (STUDENT_ID INTEGER,

    ADD1 CHAR(6),
    SEG1 CHAR(2),
    ADD2 CHAR(6),
    SEG2 CHAR(2),
    ADD3 CHAR(6),
    SEG3 CHAR(2),
    ADD4 CHAR(6),
    SEG4 CHAR(2),
    ADD5 CHAR(6),
    SEG5 CHAR(2),
    ADD6 CHAR(6),
    SEG6 CHAR(2),
    DROP1 CHAR(6),
    DSEG1 CHAR(2),
    DROP2 CHAR(6),
    DSEG2 CHAR(2),
    DROP3 CHAR(6),
    DSEG3 CHAR(2),
    DROP4 CHAR(6),
    DSEG4 CHAR(2),
    DROP5 CHAR(6),
    DSEG5 CHAR(2),
    DROP6 CHAR(6),
    DSEG6 CHAR(2));

/* Table: CLASSES, Owner: SYSDBA */
CREATE TABLE CLASSES (CRS_ID CHAR(6) NOT NULL,

    INST VARCHAR(15),

79

```
        LOCATION VARCHAR(6),
        SGMNT CHAR(2) NOT NULL);


/* Table: CODES, Owner: SYSDBA */
CREATE TABLE CODES (CRS_CODE CHAR(2) NOT NULL,
        DEPT_CODE CHAR(2),
CONSTRAINT CODES_PK PRIMARY KEY (CRS_CODE));


/* Table: COURSES, Owner: SYSDBA */
CREATE TABLE COURSES (CRS_ID CHAR(6) NOT NULL,
        CRS_NAME CHAR(50),
        HRS NUMERIC(4, 1),
        LABHRS NUMERIC(4, 1),
CONSTRAINT COURSES_PK PRIMARY KEY (CRS_ID));


/* Table: CURRIC, Owner: SYSDBA */
CREATE TABLE CURRIC (CURRICNUM CHAR(3) NOT NULL,
        CURRICNAME VARCHAR(48),
        CODE CHAR(2));


/* Table: DEPT, Owner: SYSDBA */
CREATE TABLE DEPT (CODE CHAR(2) NOT NULL,
        NAME VARCHAR(48),
CONSTRAINT DEPT_PK PRIMARY KEY (CODE));


/* Table: NAME, Owner: SYSDBA */
CREATE TABLE NAME (STUDENT_ID INTEGER NOT NULL,
        LNAME VARCHAR(24) NOT NULL,
        FNAME VARCHAR(20) NOT NULL,
        MI VARCHAR(4),
        SSN CHAR(9) NOT NULL,
        ARR_DATE DATE,
        PRD DATE,
        CURRIC CHAR(3),
CONSTRAINT NAME_PK PRIMARY KEY (STUDENT_ID),
CONSTRAINT SSN_UNIQUE UNIQUE (SSN));
```

/* Table: STUDENT, Owner: SYSDBA */

CREATE TABLE STUDENT (STUDENT_ID INTEGER NOT NULL,

    CURRICNUM CHAR(3) NOT NULL,

    SGC_NUM CHAR(4),

    SECTION CHAR(4));

/* Table: STU_MATRIX, Owner: SYSDBA */

CREATE TABLE STU_MATRIX (STUDENT_ID INTEGER NOT NULL,

    QUARTER VARCHAR(11) NOT NULL,

    ACT1 CHAR(6),

    ACT2 CHAR(6),

    ACT3 CHAR(6),

    ACT4 CHAR(6),

    ACT5 CHAR(6),

    ACT6 CHAR(6),

    SEG1 CHAR(2),

    SEG2 CHAR(2),

    SEG3 CHAR(2),

    SEG4 CHAR(2),

    SEG5 CHAR(2),

    SEG6 CHAR(2));

ALTER TABLE ADDDROP ADD FOREIGN KEY (STUDENT_ID) REFERENCES NAME(STUDENT_ID);

ALTER TABLE CURRIC ADD FOREIGN KEY (CODE) REFERENCES DEPT(CODE);

ALTER TABLE CLASSES ADD FOREIGN KEY (CRS_ID) REFERENCES COURSES(CRS_ID);

CREATE GENERATOR STUDENT_ID_GEN;

/* View: ITM_VIEW, Owner: SYSDBA */

CREATE VIEW ITM_VIEW (STUDENT_ID, LNAME, FNAME, MI, SSN, CURRIC) AS

SELECT STUDENT_ID, LNAME, FNAME, MI, SSN, CURRIC FROM

NAME WHERE CURRIC = "370"

81

```
;
SET TERM ^ ;


/* Triggers only will work for SQL triggers */
CREATE TRIGGER GET_STUDENT_ID FOR NAME
ACTIVE BEFORE INSERT POSITION 0
AS BEGIN

  NEW.STUDENT_ID = GEN_ID(STUDENT_ID_GEN, 1);

END
^
COMMIT WORK ^
SET TERM ; ^


/* Grant permissions for this database */
```

# APPENDIX E. USER MANUAL

A. INSTALLATION AND CONFIGURATION

Install Intrabuilder on the web server. The Intrabuilder Server and Interbase Server are required to run the program. Interbase can be installed on the local server or remotely on another computer. The Borland Web server can be installed or you can run what is already installed on your computer. Place the database file "student.gdb" in a directory of your choice and run the Borland Database Engine (BDE) configuration utility "bdecfg32.exe" to create an alias for the database. The alias must be named "student" for the applications to recognize it. You must provide a path-name to the physical location of the database file, such as "C:/Thesis/student.gdb". If you have a BDE already installed on your computer, save a copy of the configuration file prior to installing Intrabuilder.

Install the program files "home.jfm", "test.jfm", "adddrop.jfm", "addroprep.jfm", and "checkin.jfm" in a directory inside of the Intrabuilder directory, such as C:/Intrabuilder/Apps/Stuff/checkin.jfm.

B. USING THE PRE-REGISTRATION APPLICATION

"Home.jfm" is an interim web page which provides hyperlink access to all of the applications, so this should be the first file loaded. Open the browser and type "http://servername/svr/intrasrv.isv?apps/stuff/home.jfm" where "servername" is the IP address or domain name of your web server. When this page opens, bookmark it on your browser so that you will not have to retype it again.

Under the student utilities section of "home.jfm" is the hyperlink to Pre-Registration. Click on that link and the first of two login screens will appear (Fig. E-1). Clicking on the drop-down box will show a list of various Systems Management curricula. Select "Information Technology Management" and click the "Next" button at the bottom of the screen.

83
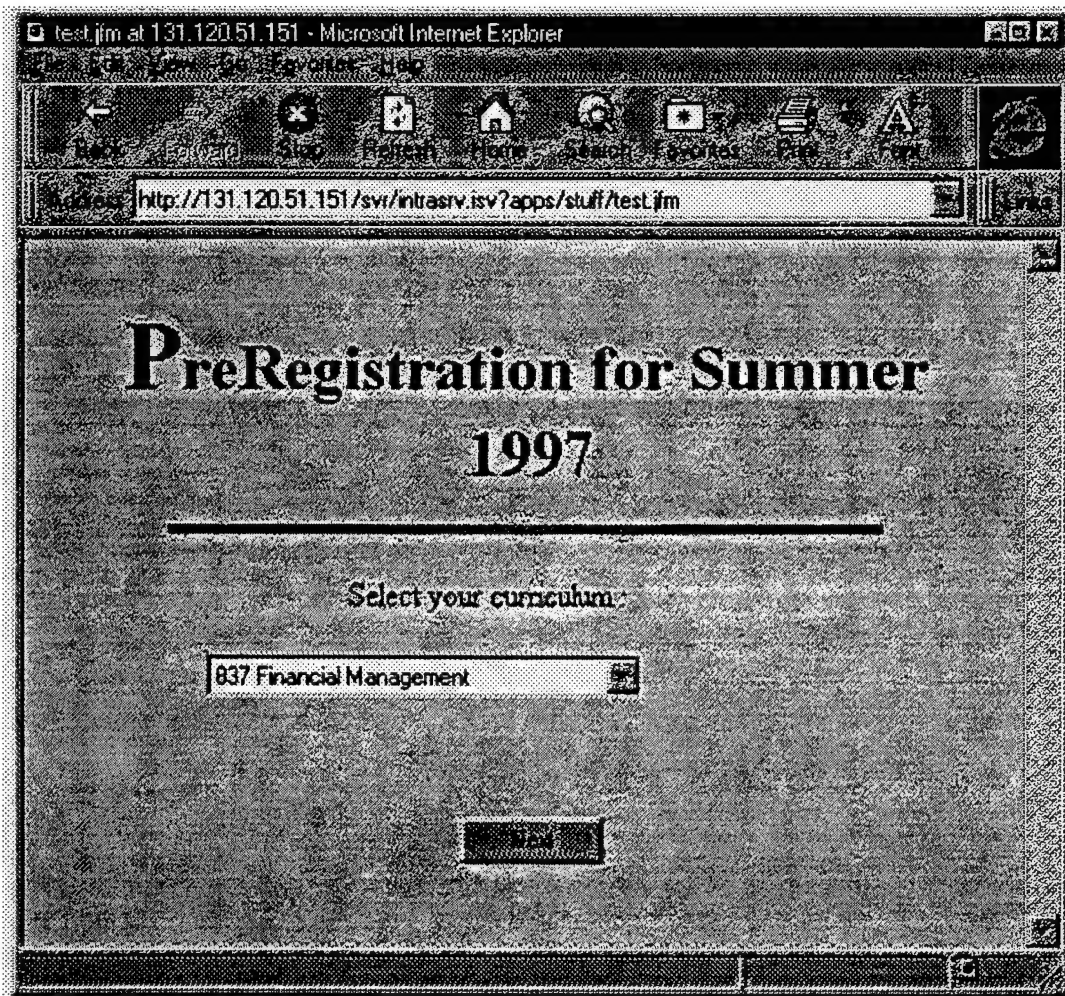
Figure E-1. Pre-Registration Login Form Page 1

The second page of the login screen will open (fig. E-2), prompting for a Social Security Number (SSN). Enter the SSN with no dashes for the test case "000000000" and click the "Next" button at the bottom of the screen.

The main Pre-registration form (fig. E-3) will open, listing all of the courses or "activities" which are listed in the student's matrix for the quarter of registration. The student can add or delete courses as needed, by using the six digit course codes, and click on the "Save" button at the bottom of the form when Pre-registration is completed. If the student needs to investigate courses, there is a link to "browse the online course catalog", which opens the catalog of courses maintained online by the Registrar's Office.
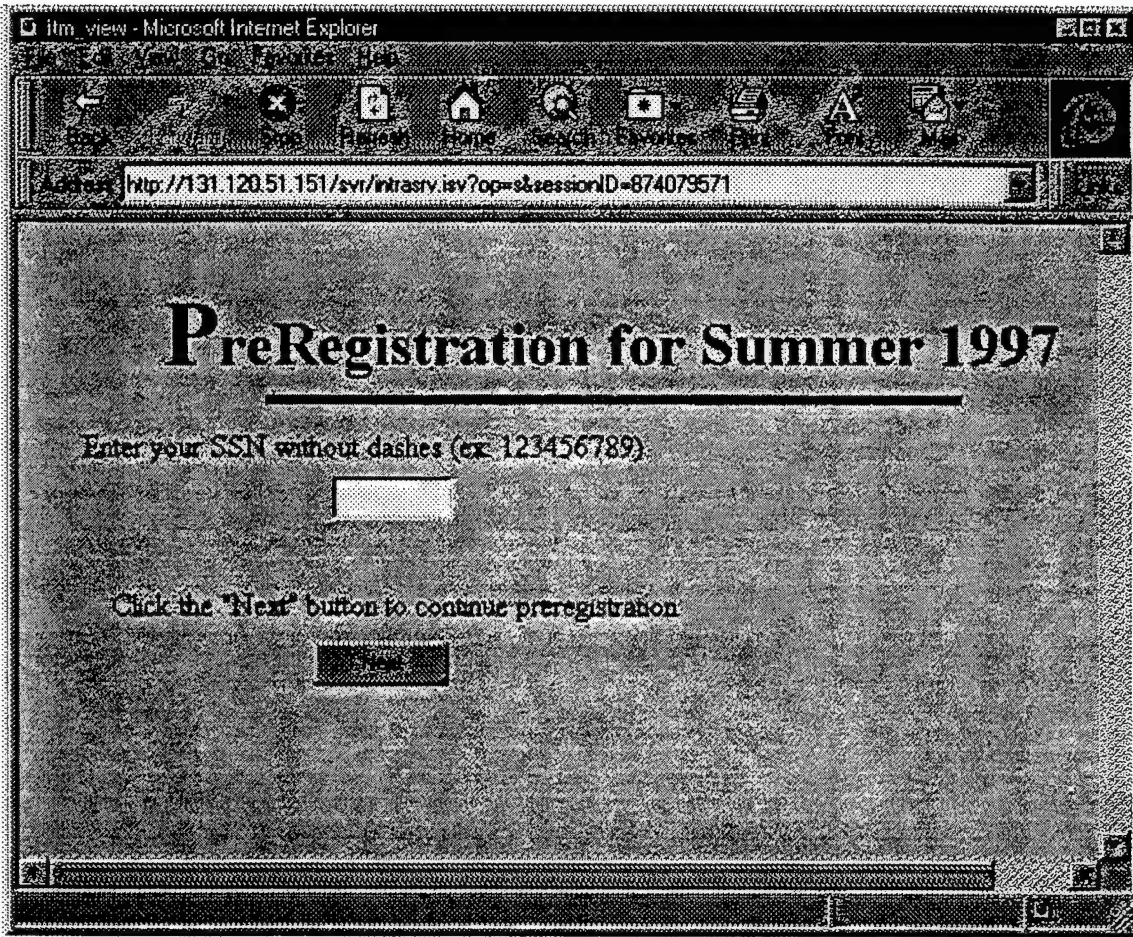
Figure E-2. Pre-Registration Login Page 2

When the "Save" button is clicked on the main pre-registration form, the data is posted to the student's matrix in the database and the pre-registration summary screen (fig. E-4) is opened. The summary provides the student with a summation of the courses and hours for the registration quarter. When completed viewing the summary, the student must use the "back" button on the browser to back out of the pre-registration application and return to "home.jfm".

PreRegistration for Summer 1997

If your name is not listed below, STOP. Log off of your machine and see the Systems Management Ed Tech in IN 217

REECE MORGAN

The courses which appear below are taken from your current course matrix. Please enter the courses which you desire to attend in the Summer 1997 quarter. You MUST be enrolled in at least 4 activities each quarter but no more than 6. Valid activities include courses, directed studies, and thesis research (0810) studies.

Activity 1:	IS 2000	Activity 4:	CS 3030
Activity 2:	IS 3170	Activity 5:	
Activity 3:	EO 3513	Activity 6:	

Browse the online course catalog

After entering any changes to your requested courses, you must SAVE them by clicking the SAVE button below. If you discover that you have made an error and the preregistration period has not closed, you can resubmit this form with the correct courses and the previous selections will be overwritten. After the preregistration period has closed, any changes will require submitting an add/drop form after the Summer 1997 quarter has begun.

Save

Figure E-3. Pre-Registration Main Screen

86

PreRegistration Summary

REECE MORGAN

PM61

Course ID	Name	Hrs	Lab Hrs
IS2000	Introduction to Computer Management	4	1
IS3170	Economic Evaluation of Information Systems I	4	1
EO3513	Communications Systems Engineering	4	1
CS3030	Computer Architecture and Operating Systems	4	1

TOTAL HRS: 18.00

Figure E-4. Pre-Registration summary screen

C. USING THE ADD/DROP APPLICATION

From the "home.jfm" page, select the "Add/Drop Courses" hyperlink under student utilities. This will open the login screen (fig. E-5) which prompts the user for a curriculum and SSN. Select "Information Technology Management" from the drop-down box and type the test case SSN "000000000" into the text box with no dashes. Click on the "Next" button at the bottom of the page.

Figure E-5. Add/Drop Login Screen

The drop courses page appears next (fig. E-6). Clicking on the drop-down boxes reveals all of the courses in which a student is enrolled for the present quarter. The student selects those courses which he wishes to drop and clicks on the "Next" button at

Figure E-6. Drop Courses Screen

the bottom of the page. If a student does not desire to drop any courses, the drop-down boxes are left blank and clicking on the "Next" button takes him to the add courses page.

On the add courses page (fig E-7), the user will fill in the course number and segment of those classes that he or she wishes to add for the quarter. If no additions are desired, this page is left blank. When the user clicks on the "Next" button, the courses

listed on the add courses page are compared against the database which contains the classes that are being offered for that quarter. If the course number and segment do not match the database, they are not listed on the add/drop approval form (fig. E-8), which is the next page that loads.

Figure E-7. Add Courses Screen

The user will print the add/drop approval form for routing to professors, the academic associate, curricular officer, and education technician. When the education technician receives the approved add/drop slip, he or she will open a utility which is used

CHANGE OF REGISTRATION
JUL-SEP 1997 ACADEMIC QTR

student name:
MORGAN, REECE

student SSN:
000000000

number #
370

NOTE: Change of Registration Forms must have the APPROVAL SIGNATURES of both the Academic Associate and the Curricular Officer PRIOR to being taken to the individual Instructor for signature.

COURSE WITHDRAWALS (DROPS)

Course Number	Segment	Instructor name	Instructor signature and date (DD/MM/YY)
IS2000	2	Bui	
IS3170	3	Haga	

COURSE ENROLLMENTS (ADDS)

Course Number	Segment	Instructor name	Instructor signature and date (DD/MM/YY)
CS3030	5	Wong	
EO3513	4	French	

Academic Associate signature

Curricular Officer signature

Figure E-8. Change Registration Report

91

to accept the changes to the student's matrix in the master database. Until the changes are approved, the requested add/drop changes reside in a separate table of the database.

D. USING THE NEW STUDENT CHECK-IN APPLICATION

This application is run by clicking on the "new student check-in" link on the home.jfm page. The first page requests the student's SSN(without dashes) and curriculum and is similar to fig. E-5. Clicking on the "Next Page" button loads the second page, which displays the students name, SSN, and curriculum and requests personal and professional information. The other four pages of the application request additional information. Students fill in the information requested on each page and click the "Next Page" button to advance to the following page. Some of the information is required to be provided, some of it is not. If some required information is unknown by the student, they can run the application at a later date to provide the data. A query will be conducted on the database at a designated time after a new group of students arrive to determine what required information is missing.

REFERENCES

[1] R. Bernard, The Corporate Intranet, John Wiley and Sons, 1996.

[2] The Intranet-A Corporate Revolution,
     http://www.intranet.co.uk/intrapaperset.html

[3] A Brief History of the Internet, http://info.isoc.org/internet-history/#Future

[4] S. L. Telleen, Intranet Organization: Strategies for Managing Change,
     http://www.intranetpartners.com/IntranetOrg/index.html

[5] G. James, Intranets Rescue Reengineering, Datamation, December 1996.

[6] R. Orfali, D. Harkey, and J. Edwards, The Essential Client-Server Survival Guide,
     John Wiley and Sons, 1994.

[7] D. Kroenke, Database Processing, (Prentice Hall, Englewood Cliffs, NJ, 1995).

[8] A. Cortese, Here Comes the Intranet,
     http://www.businessweek.com/1996/09/960226

[9] Jones Telecommunications and Multimedia Encyclopedia,
     http://www.digitalcentury.com/encyclo/update/pc_hd.html

[10] T. Berners-Lee, R. Cailliau, A. Luotonen, H.F. Nielsen, A. Secret, The World Wide
      Web, Communications of the ACM, August 1994, Vol. 37, No. 8.

[11] Interview, Jack Fraser, Webmaster, Pacific Bell Technology Services Group, 26 July
      1996.

[12] Interview, Fran Current, Director , Internet Technologies Project, Sandia National Laboratory,
      August 21, 1997.

[13] B. Violino, Intranets: Not Safe Either, Information Week, Feb. 19, 1996.

[14] Christine A. Quinn, From Grass Roots to Corporate Image - The Maturation of the Web,
http://www.ncsa.uiuc.edu/SDG/IT94/Proceedings/Campus.Infosys/quinn/quinn.html

[15] D. West and B. Norris, master's thesis: Digital Libraries, June 1996.

[16] A. Steinke and P. Bristow, Developing Geographic Services on the WWW.
http://www.life.csu.edu.au/~asteinke/conference/sydney/gis/paper.html

[17] http://www.weissbach.com/Documents/Cookie.html

[18] B. Bowen, How Popular Sites Use Cookie Technology
http://www.netscapeworld.com/nw-04-cookies.html

[19] W. Fisher, What the World Wide Web can do and how,
http://www.qut.edu.au/cs/staff/fisher/queswww.html

[20] Interview with Ray Luevano, Regional Sales Director, Sun Microsystems , May 1997.

[21] L. Smith, By The Numbers, PC Week, June 18, 1996.

[22] White Paper, The New Way to Share Workgroup Information,
http://www.netscape.com/comprod/at_work/white_paper/gold_white_paper.html

[23] White Paper, Intranets Redefine Corporate Information Systems,
http://partner.netscape.com/comprod/at_work/white_paper/indepth.html

[24] White Paper, The Intranet,
http://www.hummingbird.com/whites/intranet.html

[25] F. Derfler, Jr., A Universal Client?, PC Magazine, April 23, 1996.

[26] White Paper, Making Intranets Put the Web to Work for You,
http://techweb.cmp.com/intranet-build/6b.htm

[27] R. Cherry, Internet/Intranet Issues,
    http://www.mrj.com/tech/whitepaper.htm

[28] White Paper, Internet/Intranet Firewall Security for TCP/IP and IPX Networks:
    A Manageable, Integrated Solution,
    http://www.ukiahsoft.com/securitywp.html

[29] D. Russell and G. Gangemi, Computer Security Basics,
    O'Reilly and Associates, 1992.

[30] White Paper, Cryptography Is The Key To Intranet Security Needs,
    http://www.techweb.com/se/linkthru.cgi?CRN19970630S0089

[31] Naval Postgraduate School Catalog, 1997.

[32] White Paper, VisualGen Team Suite,
    http://www.dsdm.org/visulgen.html

[33] RAD Overview,
    http://www.systemhouse.mci.com/shltdemo/segments/lds00001/method/meth/mm900/
    mm900nd2.htm

[34] K. Kendall and J. Kendall, Systems Analysis and Design, Prentice Hall, 1995

[35] G. Zolla, Research Summary: Determinants of Successful Intranet Implementation, August 1997.

[36] Intranet Implementation Issues,
    http://techweb.cmp.com/intranet-build/stepm.htm

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center 2
   8725 John J. Kingman Rd., Ste 0944
   Ft. Belvoir, VA 22060-6218

2. Dudley Knox Library 2
   Naval Postgraduate School
   411 Dyer Rd.
   Monterey, CA 93943-5101

3. Dean of Computer and Information Services, Code 05 2
   Naval Postgraduate School
   Monterey, CA 93943

4. Professor Suresh Sridhar, Code SM/Sr...2
   Department of Systems Management
   Naval Postgraduate School
   Monterey, CA 93943

5. LT Reece Morgan 2
   Department of Computer and Information Services
   Naval Postgraduate School
   Monterey, CA 93943

6. George Zolla, Code Xy..1
   Dudley Knox Library
   Naval Postgraduate School
   411 Dyer Rd.
   Monterey, CA 93943-5101